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**INTERFACE CONTROL DOCUMENT
FOR THE
PRODUCT SPECIFICATION**

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INTRODUCTION

The Product Specification Interface Control Document is an internal engineering document for detail design criteria for the SS meteorological products.

SCOPE

The product descriptions and the product range/resolution of the 31 October 2001 issue of 2810000D, WSR-88D System Specification, form the basis for the product specification. The specifications define special symbols and characters.

Appendix A contains standard and product specific units and dimensions, symbols, abbreviations, parameters and display features. These are also defined in each product specification.

Appendix B contains product display formats. Alphanumeric tabular formats are contained in C.

1 REFLECTIVITY (R AND DR)

1.1 SS Product Description

"This product shall provide the reflectivity data displayable as an image¹ and formatted as a data array. For the image version, variations of the product shall be organized to provide various areas of coverage and display resolutions, while the data array version will provide the highest resolution available for the entire coverage area. Both versions will be limited to the lowest 70,000 feet AGL of the atmosphere. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each scan shall be updated once per volume scan time.² For the image version, each product shall be available for both 8 and 16 reflectivity data levels, while 256 reflectivity data levels will be provided in the data array version. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, maximum data value (dBZ), radar position, radar elevation above MSL, and radar operational mode."

1.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

1.2.1 Data Levels

For the image version, the range of data level values (dBZ) varies with operational mode, area climatology and season, and with NEXRAD system (or agency) adaptation data. The range of reflectivity supported by the RDA is -32 to +95 dBZe.

1.2.2 Color Level Code Tables

The color level code used for display of the image version of reflectivity is NEXRAD (or agency) system adaptation data. Some examples of color tables for both Modes A and B are listed. With the exception of the end points, the lower value of the range is assigned to the individual colors displayed. The range of values for each is also indicated.

"¹Defines the form of presentation on a graphic display; not necessarily the form of transmission."

"²Defined in Appendix B"

Color Level Codes

Precipitation Mode

16-Level Code	Display dBZ	Range dBZ	Color Levels Code	Color
0	ND	SNR<TH OR dBZ<5	(00 00 00)	black
1	5	5≤dBZ<10	(9C 9C 9C)	medium gray
2	10	10≤dBZ<15	(76 76 76)	dark gray
3	15	15≤dBZ<20	(FF AA AA)	light pink
4	20	20≤dBZ<25	(EE 8C 8C)	medium pink
5	25	25≤dBZ<30	(C9 70 70)	dark pink
6	30	30≤dBZ<35	(00 FB 90)	light green
7	35	35≤dBZ<40	(00 BB 00)	medium green
8	40	40≤dBZ<45	(FF FF 70)	light yellow
9	45	45≤dBZ<50	(D0 D0 60)	dark yellow
A	50	50≤dBZ<55	(FF 60 60)	light red
B	55	55≤dBZ<60	(DA 00 00)	medium red
C	60	60≤dBZ<65	(AE 00 00)	dark red
D	65	65≤dBZ<70	(00 00 FF)	blue
E	70	70≤dBZ<75	(FF FF FF)	white
F	75	75≤dBZ	(E7 00 FF)	purple

Color Level Codes

Clear Air Mode

16-Level Code	Display dBZ	Range dBZ	Color Levels Code	Color
0	ND	SNR<TH or dBZ<-28	(00 00 00)	black
1	-28	-28≤dBZ<-24	(9C 9C 9C)	medium gray
2	-24	-24≤dBZ<-20	(76 76 76)	dark gray
3	-20	-20≤dBZ<-16	(FF AA AA)	light pink
4	-16	-16≤dBZ<-12	(EE 8C 8C)	medium pink
5	-12	-12≤dBZ<-8	(C9 70 70)	dark pink
6	-8	-8≤dBZ<-4	(00 FB 90)	light green
7	-4	-4≤dBZ<0	(00 BB 00)	medium green
8	0	0≤dBZ<+4	(FF FF 70)	light yellow
9	+4	+4≤dBZ<+8	(D0 D0 60)	dark yellow
A	+8	+8≤dBZ<+12	(FF 60 60)	light red
B	+12	+12≤dBZ<+16	(DA 00 00)	medium red
C	+16	+16≤dBZ<+20	(AE 00 00)	dark red
D	+20	+20≤dBZ<+24	(00 00 FF)	blue
E	+24	+24≤dBZ<+28	(FF FF FF)	white
F	+28	+28≤dBZ	(E7 00 FF)	purple

Precipitation Mode and Clear Air Mode

8-Level Code	Display dBZ	Range dBZ	Color Levels Code	Color
0	ND	SNR<TH or dBZ<5	00 00 00)	black
1	5	5≤dBZ<18	(FF AA AA)	light pink
2	18	18≤dBZ<30	(C9 70 70)	dark pink
3	30	30≤dBZ<41	(00 BB 00)	medium green
4	41	41≤dBZ<46	(FF FF 70)	light yellow
5	46	46≤dBZ<50	(DA 00 00)	medium red
6	50	50≤dBZ<57	(00 00 FF)	blue
7	57	57≤dBZ	(FF FF FF)	white

1.2.3 Range/Data Resolution

The image products will be available for the range/resolution combinations as indicated.

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 124	0.54 x 1	Radar location
0 to 248	1.1 x 1	Radar location
0 to 248	2.2 x 1	Radar location

The data array product will be available for the range/resolution combination as indicated.

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 248	0.54 x 1	Radar location

1.3 Annotations

1.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

Elevation Angle

Data Level Code

Maximum Data Value Detected

1.3.2 Special Symbols

None defined

1.4 Product Interaction

All overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature

2 MEAN RADIAL VELOCITY (V AND DV)

2.1 SS Product Description

"This product shall provide the mean radial velocity data both displayable as an image and formatted as a data array. For the image version, variations of the product shall be organized to provide various areas of coverage and display resolution, while the data array version will provide the highest resolution available for the entire radar coverage area. Both versions will be limited to lowest 70,000 feet AGL of the atmosphere. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each scan shall be updated once per volume scan time. For the image version, each product shall include both 8 and 16 mean radial velocity data levels, while 256 velocity data levels will be provided in the data array version. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, maximum data value detected (knots, positive and negative), radar position, radar elevation above MSL, and radar operational mode."

2.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

2.2.1 Data Levels

For the image version, the range of mean radial velocity values will vary with operational mode and with NEXRAD system (or agency) adaptation data. The data thresholds are site adaptable. The range of values used is a function of meteorological mode and/or operator option.

2.2.2 Color Level Code Tables

The color level code used for display of the image version of mean radial velocity is NEXRAD system (or agency) adaptation data. Examples for currently defined color tables are shown. With the exception of end point values the lower value of the velocity range is assigned to the individual colors displayed. The range of values for each is also indicated.

Color Level Codes

16-Level Code	Display knots	Range knots	Color Levels Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	-64	-64≥knots	(00 E0 FF)	light blue
2	-50	-50≥knots>-64	(00 80 FF)	medium blue
3	-36	-36≥knots>-50	(32 00 96)	dark blue
4	-26	-26≥knots>-36	(00 FB 90)	light green
5	-20	-20≥knots>-26	(00 BB 99)	medium green
6	-10	-10≥knots>-20	(00 8F 00)	dark green
7	-1	0≥knots>-10	(CD C9 9F)	light gray
8	0	0≤knots<+10	(76 76 76)	dark gray
9	+10	+10≤knots<+20	(F8 87 00)	medium orange
A	+20	+20≤knots<+26	(FF CF 00)	medium yellow
B	+26	+26≤knots<+36	(FF FF 00)	yellow
C	+36	+36≤knots<+50	(AE 00 00)	dark red
D	+50	+50≤knots<+64	(D0 70 00)	medium brown
E	+64	+64≤knots	(FF 00 00)	bright red
F	RF	RF	(77 00 7D)	dark purple

8-Level Code

8-Level Code	Display knots	Range knots	Color Levels Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	-10	-10≥knots	(00 E0 FF)	light blue
2	-5	-5≥knots>-10	(00 BB 00)	medium green
3	-1	0≥knots>-5	(00 8F 00)	dark green
4	0	0≤knots<+5	(F8 87 00)	medium orange
5	+5	+5≤knots<+10	(FF CF 00)	medium yellow
6	+10	+10≤knots	(FF 00 00)	bright red
7	RF	RF	(77 00 7D)	dark purple

2.2.3 Range/Data Resolution

The image products will be available for the range/resolution combinations as indicated below. Displayed values for lower resolution products are chosen by selecting every other bin value (0.27 nmi resolution) and every fourth bin value (0.54 nmi resolution).

Coverage Area (<u>nmi Radius</u>)	Resolution (<u>nmi x deg</u>)	Product Center
0 to 32	0.13 x 1	Radar location
0 to 62	0.27 x 1	Radar location
0 to 124	0.54 x 1	Radar location

The data array product will be available for the range/resolution as indicated.

Coverage Area (nmi)	Resolution (nmi x deg)	Product Center
0 to 124	0.13 x 1	Radar location

2.3 Annotations

2.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

Elevation Angle

Data Level Code

Maximum Data Value Detected (both positive and negative)

2.3.2 Special Symbols

None defined

2.4 Product Interaction

All overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

3 SPECTRUM WIDTH (SW)

3.1 SS Product Description

"This product shall provide the radial velocity spectrum width data displayable as an image. Variations of the product shall be organized to provide various areas of coverage and display resolutions. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each scan shall be updated once per volume scan time. Each product shall be available for 8 spectrum width data levels. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, maximum data value detected (knots), radar position, radar elevation above MSL, and radar operational mode."

3.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

3.2.1 Data Levels

The range of spectrum width data values displayed is from 1 to 20 kts. Any levels exceeding 20 kts will be truncated to 20 kts.

3.2.2 Color Level Code Tables

The color level code used for display of spectrum width is NEXRAD system (or agency) adaptation data. The currently defined color table for spectrum width is listed.

8-Level Code	Display knots	Range knots	Color Levels	
			Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	0	knots<4	(76 76 76)	dark gray
2	4	4≤knots<8	(9C 9C 9C)	medium gray
3	8	8≤knots<12	(00 BB 00)	medium green
4	12	12≤knots<16	(FF 00 00)	bright red
5	16	16≤knots<20	(D0 70 00)	medium brown
6	20	20≤knots	(FF FF 00)	yellow
7	RF	RF	(77 00 7D)	dark purple

3.2.3 Range/Data Resolution

The products will be available for the range/resolution combination as indicated below. Displayed values for lower resolution products are chosen by selecting every other bin value (0.27-nmi resolution) and every fourth bin value (0.54 nmi resolution).

Coverage Area (nmi Radius)	Resolution (nmi x deg)	Product Center
0 to 32	0.13 x 1	Radar location
0 to 62	0.27 x 1	Radar location
0 to 124	0.54 x 1	Radar location

3.3 Annotations

3.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

Elevation Angle

Data Level Code

Maximum Data Value Detected

3.3.2 Special Symbols

None defined

3.4 Product Interaction

All overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

4 COMBINED SHEAR (CS)

4.1 SS Product Description

"This product shall provide the combined (radial and azimuthal) shear of the mean radial velocity for a 230 km x 230 km area centered at the radar position. The shear information presented in this product shall be the output of the Combined Shear Algorithm. It shall be presented as a displayable image of shear values containing 16 data levels. The capability to establish the product resolution shall be a UCP function. This product shall be produced for one elevation angle, as selected at the UCP, with the lowest elevation angle as the default. This product shall be updated once per volume scan time.

This product shall include annotations for product name, radar ID, date and time of elevation scan, elevation angle, data level code, position and value of maximum shear value, radar position, radar elevation above MSL, product resolution and radar operational mode. Upon user request, all site adaptable parameters identified as inputs to the algorithms used to generate data for this product shall be available at the alphanumeric display."

4.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B)

4.2.1 Data Levels

The product will contain 16 data levels. The data level code may vary with operational mode and with NEXRAD (or agency) system adaptation data. The data thresholds are site adaptable.

4.2.2 Color Level Code Tables

16-Level Code	Display <u>x 10s</u>	Range <u>x 10s</u>	Color Levels	
			Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	0	s<5	(76 76 76)	dark gray
2	5	5≤s<10	(AA AA AA)	gray
3	10	10≤s<20	(32 00 96)	dark blue
4	20	20≤s<30	(00 80 FF)	medium blue
5	30	30≤s<40	(00 FF FF)	cyan
6	40	40≤s<50	(00 8F 00)	dark green
7	50	50≤s<60	(00 BB 00)	medium green
8	60	60≤s<70	(00 FF 00)	green
9	70	70≤s<80	(C8 64 00)	brown
A	80	80≤s<90	(FF AA 00)	orange
B	90	90≤s<100	(FF FF 00)	yellow
C	100	100≤s<150	(AE 00 00)	dark red
D	150	150≤s<200	(FF 00 00)	bright red
E	200	200≤s	(FF 7D 7D)	pink
F	RF	RF	(96 00 96)	medium magenta

4.2.3 Range/Data Resolution

The resolution of the product is adaptable and ranges from 0.27 nmi by 0.27 nmi to 2.2 nmi by 2.2 nmi (choice of 0.27, 0.54, 1.1, or 2.2 nmi).

Coverage Area (nmi x nmi)	Resolution (nmi x nmi)	Product Center
124 x 124	Adaptable	Radar location

4.3 Annotations

4.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))
Elevation Angle
Maximum Shear Detected
Position of Maximum Shear
Resolution of Product
Data Level Code
Site Adaptable Parameters

4.3.2 Special Symbols

None defined

4.4 Product Interaction

All overlay products are displayed on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

4.5 Comment

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

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6 COMPOSITE REFLECTIVITY AND COMPOSITE REFLECTIVITY EDITED FOR ANOMALOUS PROPAGATION (CR AND CRE)

6.1 SS Product Description

"This product shall provide composite reflectivity data displayable as an image. For each geographical resolution element, this product shall provide the highest reflectivity value above the resolution element available from any elevation angle scan of a volume scan. This product shall be updated once per volume scan. The product shall be available for both 8 and 16 reflectivity data levels. The product shall include annotations for the product name, radar ID, time and date of scan, data level code, maximum data value (dBZ), radar position, radar elevation above MSL and radar operational mode. In addition, storm information generated by the various meteorological algorithms, e.g. the Storm Cell Identification & Tracking (SCIT) algorithm and Tornado Detection Algorithm (TDA) shall be included as annotations or graphic overlays, or both, as the user selects.

When selected, the algorithm generated information shall be provided for all identified storms. When these additional annotations or overlays are selected by the user, they shall be provided routinely until deselected. The information in these optional overlays and annotations shall be updated once per volume scan time. For the second version of this product (CRE), a clutter editor is applied to the reflectivity image data (using both velocity and spectrum width data as inputs) to remove clutter contaminated data."

6.2 Display Format

6.2.1 Graphic Display

The product is displayable in full-screen or quarter-screen format (see Appendix B).

6.2.1.1 Data Display

6.2.1.1.1 Data-Levels

The range of data level values vary with operational mode, area climatology and season, and is NEXRAD system (or agency) adaptation data.

6.2.1.1.2 Color Level Code Tables

The color level code used for display of reflectivity is NEXRAD system (or agency) adaptation data. Currently defined color tables for both 8 and 16 levels are listed in the product specification 1.2.2. A gray scale color table is available for use at PUP operator option. (The composite reflectivity gray scale will allow the overlay colors to be easily distinguishable from the composite reflectivity image.)

6.2.1.2 Range/Data Resolution

<u>Coverage Area</u> <u>(nmi radius)</u>	<u>Resolution</u> <u>(nmi x nmi)</u>	<u>Product Center</u>
124	0.54 x 0.54	Radar Location
248	2.2 x 2.2	Radar Location

6.2.1.3 Graphic Overlay

Not Applicable

6.2.2 Alphanumeric Display

Not Applicable

6.3 Annotations

Combined Attribute Table (Configuration 5, Format III, Appendix B)

6.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

Data Level Code

Maximum (CR or CRE) Data Value Detected

6.3.2 Special Symbols

None defined

6.4 Product Interaction

The following overlay prod Color Levels products are displayable on this product:

- Attribute Tables
- Hail
- Mesocyclone
- Severe Weather Probability
- Storm Track Information
- Tornado Vortex Signature.

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8 ECHO TOPS (ET)

8.1 SS Product Description

"This product shall provide the echo tops information displayed as an image. This product shall be produced from the output of the Echo Tops Algorithm. The product shall be updated once per volume scan time. The product shall be available for 16 altitude range data levels referenced to mean sea level. The product shall include annotations for product name, radar ID, time and date of scan, maximum data value detected (Height in feet, MSL), radar position, radar elevation above MSL, and radar operational mode."

8.2 Display Format

This product is displayable in full- or quarter-screen format (see Appendix B).

8.2.1 Data Levels

The product will be available for 16 altitude range levels. The range of altitude values are 5,000 feet to 70,000 feet in increments of 5,000 feet. The component with the highest altitude of each echo which meets the minimum reflectivity value specified in adaptation data (default value of 18.5 dBZ) will be used as the echo top.

8.2.2 Color Level Code Tables

16-Level Code	Display kft	Range kft MSL	Color Levels Code	Color
0	ND	No Data	(00 00 00)	black
1	0	kft<5	(00 00 00)	black
2	5	5≤kft<10	(76 76 76)	dark gray
3	10	10≤kft<15	(00 E0 FF)	light blue
4	15	15≤kft<20	(00 B0 FF)	lt medium blue
5	20	20≤kft<25	(00 90 CC)	dk medium blue
6	25	25≤kft<30	(32 00 96)	dark blue
7	30	30≤kft<35	(00 FB 90)	light green
8	35	35≤kft<40	(00 BB 00)	medium green
9	40	40≤kft<45	(00 EF 00)	bright green
A	45	45≤kft<50	(FE BF 00)	tan
B	50	50≤kft<55	(FF FF 00)	yellow
C	55	55≤kft<60	(AE 00 00)	dark red
D	60	60≤kft<65	(FF 00 00)	bright red
E	65	65≤kft<70	(FF FF FF)	white
F	70	70≤kft	(E7 00 FF)	purple

8.2.3 Range/Data Resolution

Coverage Area (nmi Radius)	Resolution (nmi x nmi)	Product Center Radar Location
0 to 124	2.2 x 2.2	

8.3 Annotations

8.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))
Maximum Data Value Detected
Data Level Code

8.3.2 Special Symbols

None defined

8.4 Product Interaction

The following overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

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10 SEVERE WEATHER ANALYSIS DISPLAY (SWA)¹

10.1 SS Product Description

"This product shall provide, at the highest product resolution available, separate maps of reflectivity, mean radial velocity, spectrum width, and radial shear for 50 km x 50 km areas. When produced because this product has been selected for generation due to the detection of an alert condition, the product shall be automatically generated for the elevation angle nearest the critical altitude* for the meteorological phenomenon causing the alert condition, and shall be centered at the coordinates of the meteorological phenomenon causing the alert condition. This product shall also be generated upon user request for a user-specified elevation angle and geographic center point.

The capability shall exist to modify the mean radial velocity map by removing the storm motion of an operator selected storm from the velocity data. The modified map shall be centered on the same geographic location as the original map. The method of removal is described in product 16, Storm Relative Mean Radial Velocity.

The product shall contain 16 data levels for each data type displayed except spectrum width which shall contain 8 data levels. The product shall include annotations for product name, radar ID, radar position, time and date of scan, elevation angle, Height (AGL) of the phenomenon centerpoint, maximum data values detected, mesocyclone, TVS, and hail."

10.2 Display Format

The product is displayable in quarter-screen Format II (see Appendix B). The name of each quarter-screen product will be displayed in addition to the name of the entire product.

The reflectivity in the upper left quadrant; velocity or the storm relative mean radial velocity in the upper right quadrant; spectrum width in the lower left quadrant; and the radial shear in the lower right quadrant.

1. The component parts of the SWA are:

SWR - Reflectivity

SWV - Velocity

SWW - Spectrum Width

SWS - Radial Shear

SRR - Storm Relative Mean Radial Velocity

Note that when requesting an SWA or an SWV, the velocity product will default to the mean radial velocity if a storm motion (or wind speed) is not specified. When specified, the product generated for the velocity will be the storm relative mean velocity region in lieu of the mean radial velocity.

*Defined in Appendix B, SS.

10.2.1 Data Levels

Sixteen data levels are used for all but spectrum width which uses 8 data levels.

10.2.2 Color Level Code Tables

The color level code tables used are those listed in the following referenced subsections for each product:

- Reflectivity (1.2.2)
- Mean Radial Velocity (2.2.2) or Storm Relative Mean Radial Velocity Region (16.2.2)
- Spectrum Width (3.2.2).

Radial Shear

16-Level Code	Displayed $\times 10/s$	Shear Range $\times 10/s$	Color Levels Code	Color
0	<Threshold	<Threshold	(00 00 00)	black
1	-108	$-108 \geq 1/s$	(FF EF 00)	bright yellow
2	-72	$-72 \geq 1/s > -108$	(EF 90 00)	light orange
3	-28	$-28 \geq 1/s > -72$	(FF 22 00)	red orange
4	-12	$-12 \geq 1/s > -28$	(DD 33 33)	dark orange
5	-8	$-8 \geq 1/s > -12$	(F2 AA AA)	light purple
6	-5	$-5 \geq 1/s > -8$	(D2 77 99)	medium purple
7	-1	$0 \geq 1/s > -5$	(BA BA BA)	light gray
8	0	$0 \leq 1/s < +5$	(88 00 00)	dark brown
9	+5	$+5 \leq 1/s < +8$	(77 77 90)	medium gray
A	+8	$+8 \leq 1/s < +12$	(00 00 FF)	bright blue
B	+12	$+12 \leq 1/s < +28$	(88 82 FF)	medium blue
C	+28	$+28 \leq 1/s < +72$	(CA CA FF)	light blue
D	+72	$+72 \leq 1/s < +108$	(FF FF EE)	white
E	+108	$+108 \leq 1/s$	(FF 00 FF)	medium purple
F	RF	RF	(77 00 7D)	dark purple

10.2.3 Range/Data Resolution

Coverage Area (nmi Radius)	Resolution* (nmi) \times nmi)	Product Center
27 x 27	highest resolution available	at center of alert grid box containing the triggering phenomena or operator selection

* 0.54 nmi by 1 deg for reflectivity; 0.13 nmi for velocity and spectrum width;
0.27 nmi for radial shear and storm relative mean radial velocity.

10.3 Annotations

10.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

Elevation Angle

Data Level Code for Each Product

Maximum Data Values Detected

Product Center (Lat/Long or AZRAN)

Alert Category

Storm Velocity

Height above ground level of the window containing the meteorological phenomena.

10.3.2 Special Symbols

None defined

10.4 Product Interaction

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- TVS.

Storm Relative Mean Radial Velocity may be selected manually by operator as a substitute for the Mean Radial Velocity. The substituted velocity should be centered at the same location as the other portions of the product.

11 SEVERE WEATHER PROBABILITY (SWP)

11.1 SS Product Description

"This product shall provide an alphanumeric set of severe weather probability values displayable in a graphic map format. These severe weather probability (SWP) values shall be produced using the Severe Weather Probability Algorithm. This product shall be updated each time the VIL (Vertically Integrated Liquid) product is updated. The product shall be produced in a form that can be used to generate an alphanumeric SWP value for overlaying the VIL image product or which can be displayed independently with the SWP value assigned to the VIL box corresponding to the center of an individual cell. Each product shall include annotations for the product name, radar ID, time and date of volume scan used to produce the product, data level code, maximum data value detected (percent), radar position, radar elevation above MSL, and radar operational mode."

11.2 Display Format

This product is displayable in full- or quarter-screen format (see Appendix B).

11.2.1 Data Levels

The data levels cover a range of probability values from >0 to <100 percent.

11.2.2 Color Level Code Table

			Color Levels	
4-Level Code	Display Percent	Range Percent	Code	Color
0	ND	SWP<1	(00 00 00)	black
1	20	1≤SWP<35	(00 E0 FF)	light blue
2	35	35≤SWP<50	(FF FF 00)	yellow
3	50	50≤SWP	(FF 00 00)	bright red

11.2.3 Range/Data Resolution

Coverage Area (nmi Radius)	Resolution (nmi x nmi)	Product Center Radar location
0 to 124	2.2 x 2.2	

Notes:

1.The SWP box size will be adaptable and expandable in odd multiples of a 2.2 nmi by 2.2 nmi box (e.g., 15.4 by 15.4, 19.8 by 19.8, 24.2 by 24.2). The highest probability value detectable in a box will be placed in that SWP box.

2.At the full range, the minimum SWP box has to be 8.8 nmi by 8.8 nmi to accommodate two 7 by 9 pixel alphanumeric integers. Magnification is available to increase the image size of the SWP box to accommodate alphanumerics and background map detail and still maintain the 2.2 nmi by 2.2 nmi resolution.

11.3 Annotations

11.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))
Data Level Code
Maximum Data Value Detected
SWP Box Size

11.3.2 Special Symbols

None defined

11.4 Required User Input Parameters and Defaults

<u>Input Parameters</u>	<u>Defaults</u>
Date/Time	The most recent completed volume scan for which VIL values were calculated
SWP Box Size	24.2 x 24.2 nmi
Background Map	PUP Adaptation Data

11.5 Product Interaction

This product is displayable as an overlay on all geographically based products.

12 VELOCITY AZIMUTH DISPLAY (VAD), (VWP)

12.1 SS Product Description

"This product shall provide the Velocity Azimuth Display Algorithm derived wind speed and direction. Two versions of the product shall be produced. For the first version, the wind speed and direction at up to 30 altitudes shall be computed and displayed as wind barbs on a height scale. The specific altitude levels at which VAD winds are computed and reported shall be site adaptable in one thousand feet increments. The specific altitudes at which winds are requested shall be used to derive the specific slant range and elevation angle for the VAD algorithm analysis. The use of look up tables relating a specific slant range and elevation angle to a specific wind reporting altitude for computational efficiency is permitted. To facilitate this, off-line processing may be used to generate new look-up tables whenever adaptation parameters are changed or new scanning sequences are invoked. The specific method of computing slant range and elevation angle are subject to Government approval.

Wind speed and direction will be reported to the highest altitude level at which sufficient signal is available for processing by the VAD algorithm. This product will be produced in a tabular format of alphanumeric values and as a stand-alone graphic product. The graphic product will contain the current and up to 10 previous height plots (user selectable) displayed simultaneously on a time versus height scale. This version of the product will include annotations for the product name, radar ID, radar position, radar elevation above MSL, time and date of volume scan, and maximum wind speed and associated direction of most current plot. Altitude levels will be shown referenced to mean sea level. The alphanumeric format will contain all wind data derived by the VAD algorithm for the current volume scan. Upon user request, all site adaptable parameters identified as input to the algorithm used to generate data for this product will be available at the alphanumeric display.

A second version of the VAD winds product shall be produced upon user request. This version shall present the VAD wind analysis for a specific altitude. The data displayed shall consist of the Doppler velocity data used to compute the VAD wind and the best fit function used to determine the horizontal wind speed and direction. The data shall be presented to the user as a graphical plot of the actual Doppler velocity and the best fit function on an orthogonal axis of speed versus azimuth.

The vertical axis presented shall be speed, scaled as necessary, to allow all data to be displayed. The Nyquist velocity for the specific scan shall be graphically annotated on the display if the range of the scaled vertical axis is sufficient. The horizontal axis shall be azimuth, scaled from 0-360 degrees with true North as 0/360 degrees. This product shall be available for any wind value included in the most recent time-height cross-section of the VAD Winds Product. This version of the product shall include annotations for the product name, radar ID, radar position, radar elevation above MSL, time and date of volume scan, slant range, elevation angle, wind speed and direction, computed altitude of winds, RMS error, and best fit function in the form $A_1 + V \sin(\theta + \delta)$. (See Algorithm Report.)"

12.2 Display Format

The VWP is displayable in grid Format IVA, Appendix B. The grid is considered to be part of the image and will always be displayed simultaneously with the image.

The grid for the VWP will consist of a vertical scale for altitude in thousands of feet above MSL and a horizontal time scale. The specific altitude levels are site adaptable. The vertical grid scale for the heights will be divided to equally space the number of heights that are selected. It will not be necessarily scaled since the screen is not large enough to accommodate the total interval that is

possible to select. The adaptation data may have intervals of varying increments of 1,000. The horizontal time scale will accommodate up to 10 previous user selectable height plots (e.g., the last 10 volume scans in addition to the current volume scan).

The altitude levels will be indicated in thousands of feet along the right and left ordinates and the time (hour and minutes) along the abscissa. Full screen display will be used for this product. Wind barb units will be in knots. Direction in both cases will be the direction from which the wind is blowing in degrees.

The VAD product is displayable in grid Format IVB, Appendix B. The grid is considered to be part of the image and will be displayed simultaneously with the image. In addition, the Nyquist Velocity for the specified scan will be graphically annotated on the display if it falls within the range of the scaled vertical axis.

The grid for the VAD product consists of a vertical scale for velocity and a horizontal scale for azimuth. The equation for the FIT function in the form of $A_1 + V \sin(A\epsilon + \delta)$ will also be displayed. The vertical scale is labeled with velocity values scaled such that all the data fits on the display. The unit for the velocity grid is knots. The horizontal scale is labeled with azimuth in 0 to 360 degrees. True North is 0/360 degrees. The FIT function is defined as above, where A_1 , V and δ corresponds to CF1, SPW and -DW-90 as defined in the NEXRAD Algorithm Report.

The velocity values will be plotted as individual points on the orthogonal axis and overlaid with the best fit sine wave function.

12.2.1 Data Levels

For the VWP product, the wind vector flag shaft origin will be plotted to the appropriate elevation (ordinate) and time (abscissa) intersection.

The wind vector will be plotted at the height at which it was observed. If the wind is calm, i.e., sufficient echoes are present but velocities are <5 knots, then a circle 5 pixels in diameter is placed at the appropriate point.

12.2.2 Color Level Code Table

For the VWP Product:

The wind vector color will reflect the RMS code as follows:

5-Level Code	Display RMS/knots	Range RMS/knots	Color Levels Code	Color
1	0	$\leq \text{knots} < 4$	(00 FF 00)	green
2	4	$4 \leq \text{knots} < 8$	(FF FF 00)	yellow
3	8	$8 \leq \text{knots} < 12$	(FF 00 00)	bright red
4	12	$12 \leq \text{knots} < 16$	(00 E0 FF)	light blue
5	16	$16 \leq \text{knots}$	(FF 70 FF)	medium purple

The color level table for the VAD product:

The velocity points will be color coded to the reflectivity value at the same position. The eight-level color table is defined as follows:

Color Levels				
8-Level <u>Code</u>	Display <u>dBZ</u>	Range <u>dBZ</u>	<u>Code</u>	<u>Color</u>
0		Not Used	(00 00 00)	black
1	<5	5>dBZ	(77 77 90)	medium gray
2	5	5≤dBZ<18	(FF AA AA)	light pink
3	18	18≤dBZ<30	(C9 70 70)	dark pink
4	30	30≤dBZ<41	(00 BB 00)	medium green
5	41	41≤dBZ<46	(FF FF 70)	light yellow
6	46	46≤dBZ<50	(DA 00 00)	medium red
7	50	50≤dBZ	(00 00 FF)	blue

12.2.3 Range/Data Resolution

Coverage Area <u>(nmi Radius)</u>	Resolution <u>(nmi x nmi)</u>	Product Center
N/A	Nearest 5 kts	N/A

12.2.4 Alphanumeric Display

In the alphanumeric product (tabular format for the alphanumeric screen), if the VAD derived with at a given level is valid (i.e., failed threshold for RMS, symmetry, or number of points), data for that height shall not be included. A three-line header, which includes a title, date, time column labels, and units, shall appear at the top of each VAD Algorithm Output page. Each page contains up to 14 height levels of VAD wind data. However, if there are no valid winds in the volume scan, the VWP product will not contain VAD Algorithm Output page (s). The vertical velocity (W) and divergence (DIV) columns will contain valid data only for constant slant range wind estimates. For all other estimates, these fields shall contain "NA", indicating not applicable.

12.2.4.1 Alphanumeric Screen

The tabular format, display on the alphanumeric screen (i.e. the VWP alphanumeric product), shall include up to 52 VAD derived winds. Namely, the RPC selected altitudes (up to 30), one per elevation at a constant slant range (up to 20), and the low altitude supplemental wind (2). Wind shall be ordered by increasing altitude. The format used is specified in Appendix C.

- (a) Altitude above mean sea level in hundreds of feet
- (b) Eastward, northward components of the wind in m/s
- (c) Upward component of the wind in cm/s
- (d) Wind direction in degrees
- (e) Wind speed in knots
- (f) Scatter between velocity points and the VAD fitted curve in knots
- (g) Divergence of the wind in 10 per second
- (h) Slant range of the VAD analysis in nautical miles
- (i) Elevation angle of the VAD analysis in degrees
- (j) Adaptable VAD Parameters

12.3 Annotations

12.3.1 Alphanumeric

For the VWP Product:

Standard Annotations (Appendix A, I(A))

Data Level Code

Maximum Wind Speed (current plot)

Direction of Wind Speed (current plot)

Site Adaptable Parameters

For the VAD Product:

Standard Annotations (Appendix A, I(A))

Slant Range

Elevation Angle

Wind Speed and Direction

Root Mean Square (RMS) Error

Computed Altitude of Wind

12.3.2 Special Symbols

For the VWP Product:

The wind speed and direction will be plotted with the standard meteorological wind barb presentation. The direction will be plotted as a straight line of 20 pixels in length from the direction of the wind. The vector will terminate at the intersection of the appropriate altitude and time. Wind direction is plotted to the nearest 5 degrees and speed to the nearest 5 knots. The special symbol for the wind barbs is a flag consisting of lines which are perpendicular and to the left of the wind shaft using the scale as indicated.

2 barb (5 pixels in length) = 5 knots, example: 270° 65 kts

1 barb (10 pixels in length) = 10 knots

Full triangle (10 pixels in length and 4 pixel base) = 50 knots

Shaft length = 20 pixels

For the VAD Product:

The velocity data will be plotted as single points on the grid of velocity vs. azimuth. The best fit function will be plotted over the field of velocity points as a linked vector in a contrasting color. The span of velocity data displayed on the grid is as follows:

Velocity	Span of Velocity data (grid)
<60 kts	80 kts
60≤100	120
100≤140	160
140≤180	180
>180	400

12.4 Product Interaction

None

Document Number 2620003H
Code Identification 0WY55
WSR-88D ROC
29 July 2004
Open Build 6.0

12.5 Comment

All site adaptable parameters identified as input used to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in tabular layout showing the parameter name in one column, and value in an adjacent column.

Document Number 2620003H
Code Identification 0WY55
WSR-88D ROC
29 July 2004
Open Build 6.0

13 DELETED

14 CROSS SECTION (RCS, VCS)

14.1 SS Product Description

"This product shall provide a vertical cross section of reflectivity or mean radial velocity data displayable as an image for a user selected vector. This vector shall be defined by the operator using two end-points, up to 230 km apart, and at any orientation and location within 230 km of the radar. This product shall be produced by mapping the nearest value in range along a radial, to a point in the plane of the vertical cross section defined by the intersection of the plane and the radial. The displayable version of the product shall be produced by linearly interpolating between the mapped values, both horizontally and vertically as necessary. The product shall be generated only on request. The product shall be available for both 8 and 16 data levels defining the intensity range and velocity range data levels. The product shall include annotations for the product name, radar ID, time and date of volume scan, maximum data value and location(s), radar position, radar elevation above MSL, and the radar operational mode. The location of the vector center and the end points (az/ran) shall also be indicated."

14.2 Display Format

The product is displayable on a unique grid (Format V, Appendix B) with height as ordinate and the distance along the cross section as the abscissa. The distance grid scale of the abscissa will be one of three with the range of the data determining which grid scale is used. The three scales are 0 to 50 nmi, 0 to 80 nmi, and 0 to 120 nmi. Range marks are labeled every 5 nmi for the 0 to 50 nmi range and every 10 nmi for the remainder.

The origin of the grid represents the Western nearest or Northern end point of the vector, depending upon its orientation, and the data that is contained in the label of the grid is the range from the radar of this point. Vectors will be plotted to outline the cross section area. These vectors will show the extent of the data domain that is limited because of the length of the user supplied vector, and these outline vectors will also show the difference between the area of no data versus no radar sampled data.

The grid is considered an integral part of the product and will always be available simultaneously with the image.

14.2.1 Data Levels

The data level values that may be selected for reflectivity and mean radial velocity are the same as those specified in 1.2.1 and 2.2.1, respectively.

14.2.2 Color Level Code Tables

The color level code table for the Reflectivity will be the 16-level table defined in 1.2.2. The Velocity table will be the 16-level velocity table defined in 2.2.2. The grid color will be light gray.

14.2.3 Range/Data Resolution

Coverage Area (R-Z plane)	Resolution (nmi x nmi)	Product Center
124 nmi x 70 kft	0.54 nmi	N/A
Altitude	Horizontal x 0.27 nmi Vertical	

14.3 Annotations

14.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))
Maximum Data Value Detected
Location of Maximum Data Values
Location of Vector Center (AZRAN)
Location of Vector End Points (AZRAN)
Data Level Codes
Base Data Type

14.3.2 Special Symbols

None defined

14.4 Product Interaction

None

Document Number 2620003H
Code Identification 0WY55
WSR-88D ROC
29 July 2004
Open Build 6.0

15 DELETED

16 STORM RELATIVE MEAN RADIAL VELOCITY (SRM, SRR)

16.1 SS Product Description

"This product shall provide mean radial velocity for: (a) a small geographic area centered upon or near an identified storm of interest with the storm motion removed, or (b) the entire area of radar coverage (to 230 km) with the average storm motion removed. This product shall be produced upon request for any azimuth scan at any elevation angle. The product shall be generated as a displayable image by removing the radial (velocity component away from the radar antenna) component of storm motion from the mean radial velocity values. The radial component of storm motion shall be computed using the storm motion value computed for the identified storm by the Storm Cell Tracking Algorithm, the vector average of all currently identified storms or a value input by the user. The value of storm motion used to adjust the mean radial velocity values shall be user selectable at the time of product request, or default to the vector average of all currently identified storms if not selected. Each product shall contain 16 data levels for storm-adjusted mean radial velocity. Each product shall include annotations for the product name, radar ID, time and date of scan, elevation angle, storm motion, coordinates of product center, radar position, radar elevation above MSL, and radar operational mode."

16.2 Display Format

Each product version is displayable in full- or quarter-screen format (see Appendix B).

16.2.1 Data Levels

Both product versions use 16 data levels. The data level code may vary with operational mode and with NEXRAD (or agency) system adaptation data. One currently identified velocity table is shown.

16.2.2 Color Level Code Tables

			Color Levels	
16-Level Code	Display knots	Range knots	Code	Color
0	ND	SNR<TH	(00 00 00)	black
1	-50	-50≥knots	(00 E0 FF)	light blue
2	-40	-40≥knots>-50	(00 80 FF)	medium blue
3	-30	-30≥knots>-40	(32 00 96)	dark blue
4	-22	-22≥knots>-30	(00 FB 90)	light green
5	-10	-10≥knots>-22	(00 BB 00)	medium green
6	-5	-5≥knots>-10	(00 8F 00)	dark green
7	-1	0>knots>-5	(CD C0 9F)	light gray
8	0	0≤knots<+5	(76 76 76)	dark gray
9	+5	+5≤knots<+10	(F8 87 00)	medium orange
A	+10	+10≤knots<+22	(FF CF 00)	medium yellow
B	+22	+22≤knots<+30	(FF FF 00)	yellow
C	+30	+30≤knots<+40	(AE 00 00)	dark red
D	+40	+40≤knots<+50	(D0 70 00)	medium brown
E	+50	+50≤knots	(FF 00 00)	bright red
F	RF	RF	(77 00 7D)	dark purple

16.2.3 Range/Data Resolution

Coverage Area

(a) (nmi x nmi)	Resolution	Product
<u>(b) (nmi radius)</u>	<u>(nmi x deg)</u>	<u>Center</u>
Version (a) 27 x 27 (Region)	0.27x1	Location of storm center
Version (b) 0 to 124 (Map)	0.54x1	Radar location

16.3 Annotations

16.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

Elevation Angle

Coordinates of Product Center (AZRAN or Lat/Long)

Data Level Code

Maximum Data Values Detected (after storm motion removal)

Motion Vector*

Height Above Ground level of the Window Containing the Meteorological Phenomena**

16.3.2 Special Symbols

None defined

16.4 Product Interaction

All overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

*Either a mean for all storms (map), or for one particular storm (region) derived from storm series algorithms or as operator input.

**Will be displayed only when Storm Relative Mean Radial Velocity Region is substituted for Severe Weather Velocity Quadrant in a Severe Weather Analysis Product.

17 VERTICALLY INTEGRATED LIQUID (VIL)

17.1 SS Product Description

"This product shall provide vertically integrated liquid values displayed as an image. The output of the VIL Algorithm shall be used to produce this product. The product shall be updated once per volume scan time. The product shall be available for 16 data levels. Each product shall include annotations for product name, radar ID, time and date of volume scan, maximum data value (VIL value,), radar position, radar elevation above MSL, and the radar operational mode.'

17.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

17.2.1 Data Levels

The VIL values displayed range upwards to a maximum adaptable value (default = 80 Kg/m²). Values greater than that value are truncated to that value.

17.2.2 Color Level Code Tables

The color level code used for display of VIL is a NEXRAD (or agency) system adaptation data. The currently defined color table for VIL is listed.

			Color Levels	
16-Level Code	Display kg m	Range kg m	Code	Color
0	ND	kg m<1	(00 00 00)	black
1	1	1≤kgm<5	(9C 9C 9C)	medium gray
2	5	5<kgm<10	(76 76 76)	dark gray
3	10	10≤kgm<15	(FA AA AA)	light pink
4	15	15≤kgm<20	(EE 8C 8C)	medium pink
5	20	20≤kgm<25	(C9 70 70)	dark pink
6	25	25≤kgm<30	(00 FB 90)	light green
7	30	30≤kgm<35	(00 BB 00)	medium green
8	35	35≤kgm<40	(FF FF 70)	light yellow
9	40	40≤kgm<45	(D0 D0 60)	dark yellow
A	45	45≤kgm<50	(FF 60 60)	light red
B	50	50≤kgm<55	(DA 00 00)	medium red
C	55	55≤kgm<60	(AE 00 00)	dark red
D	60	60≤kgm<65	(00 00 FF)	blue
E	65	65≤kgm<70	(FF FF FF)	white
F	70	70≤kgm-2	(E7 00 FF)	purple

17.2.3 Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center Radar location
0 to 124	2.2 x 2.2	

17.3 Annotations

17.3.1 Alphanumeric

The automated annotations for this product are:
Standard Annotations (Appendix A, I(A))
Data Level Code
Maximum Data Value Detected

17.3.2 Special Symbols

None defined

17.4 Product Interaction

All overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

18 STORM TRACKING INFORMATION (STI)

18.1 SS Product Description

"This product shall provide information concerning the past, present and future positions of each identified storm cell. This product shall be generated from the output of the Storm Cell Tracking and Storm Position Forecast algorithms. It shall be produced in a tabular format of alphanumeric values, as a stand alone graphic product, and in a format for generating graphic overlays to other products. This product shall be updated once per volume scan time. Each product shall include a standard set of total annotations and number of identified storm cells for which tracking is available. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

18.2 Display Format

Each storm cell identified will be given a unique ID of two characters. The first character will be a capital letter, A through Z, and the second will be a number, 0 through 9. The sequence will be A0, B0, C0,...Z0, A1,...Z9. The sequence is recycled following Z9. When there have not been any storm cells identified in a user specified "number of past volume scans", then the sequence of IDs will be reset so that the next storm cell identified will have the ID A0. See also Appendix A, I(B)(21) for more details on the Storm Cell ID.

18.2.1 Graphic Display

The product is displayable in full- and quarter-screen formats (see Appendix B, Formats I and II).

18.2.1.1 Data Display

The ID will be placed 5 pixels to the right and 5 pixels down from the current centroid positions. The ID will be white (code FF FF FF) and the background in black (code 00 00 00). See also Appendix A, I(B)(2).

When sufficient data is available, the past positions for each volume scan (up to the number of past volume scan minus the current volume scan) will be shown along with the current position and up to four future positions (e.g., +15, +30, +45, +60 min).

The forecast position interval and number of past volumes (or positions) are Unit Radar Committee (URC) level adaptation data and will vary over a range of 5 to 60 minutes (in 5-minute increments) and 5 to 13 volume scans, respectively. The default interval is 15 minutes, and the default number of past volumes (or positions) is 10. The past positions displayed will be the actual centroid positions where each storm cell was identified for up to the specified number of past volume scans (including the current volume scan). Storm cell tracks will consist of past, current and forecast storm cell centroid positions connected by one pixel wide linear segments. The PUP operator will have the ability through a menu at the Alphanumeric Terminal to select whether to display the past and/or forecast tracks and positions.

In the event an identified storm cell's forecast speed is less than a user-specified minimum speed, the storm cell's motion is considered stationary. For stationary storm cells, no past or forecast storm cell positions will be displayed. The minimum storm cell speed is URC level adaptation data and will vary over the range of 0.0 m/s to 10.0 m/s. The default is 2.5 m/s.

Note: See "Special Symbols and Characters" of Appendix A, 1(B)(2)) for more details on the Storm Cell Track

The PUP operator will have the ability through a one level password protected menu at the Alphanumeric Terminal to select a maximum number of storm cells for display within the current display area (or window). The default is 20 storm cells. When the number of identified storm cells in the current window exceeds the maximum number of cells for display, the storm cells with the largest Cell-based VIL will be selected for display and a message will be displayed in the lower left corner of the screen indicating the number of identified storm cells in the current window which are not displayed. The message will have the same format as in the following example: "4 CELLS IN WINDOW NOT DISPLAYED". If the number of storm cells not displayed in the current window changes, the message will change as well.

18.2.1.2 Range/Data Resolution

Coverage Area	Resolution (<u>nmi</u>)	
(<u>nmi radius</u>)	<u>x nmi</u>	Product Center
0 to 248	N/A	Radar location

18.2.1.3 Graphic Overlay

As a graphic overlay to other products, only the overlay portion of the graphic display product is displayed; that is, the screen right annotations are not displayed. Symbols and characters are described in the data display above.

18.2.2 Alphanumeric Display

18.2.2.1 Alphanumeric Screen

A tabular format (Appendix C) of up to an adaptable number of identified storms cells will be displayable on the alphanumeric display screens. The tabular format will include:

- (a) Storm Cell ID
- (b) Current storm Position in (AZRAN) degrees and nmi to the nearest integer from the RDA
- (c) The Forecast Direction in degrees (to the nearest integer) from which the storm cell is moving
- (d) The Forecast Speed of the storm cell in kts to the nearest integer
- (e) The azimuth and range forecast position of the storm cell to the nearest integer in degrees and nmi for each forecast interval up to four forecast positions
- (f) The forecast error and mean forecast error in nmi to the nearest 0.1 nmi
- (g) On the first page, Average Storm Cell Speed in kts to the nearest integer
- (h) On the first page, Average Storm Cell Direction in degrees to the nearest integer
- (i) Storm Cell Tracking/Forecast Position Adaptable Parameters

By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the UCP operator has the capability to limit the number of storm cells included in this format from 7 to 100.

Note: Storm cells which are new (i.e., lack history) shall indicate "NEW" in the Movement field.
Note: If a forecast position(s) for a storm cell can not be determined, then "NO DATA" shall be displayed for that interval in the Forecast Positions field of the alphanumeric display.

18.2.2.2 Graphic Screen

A tabular format (appendix B, Format III, configuration 1) of all identified storm cells will be displayable on the graphic display screens. The tabular format will include:

- (a) Storm Cell ID
- (b) Current Storm Position in (AZRAN) degrees and nmi to the nearest integer from the RDA
- (c) The Forecast Direction in degrees to the nearest integer from which the storm cell is moving
- (d) The Forecast Speed of the storm cell in kts to the nearest integer
- (e) The forecast error and mean forecast error in nmi to the nearest 0.1 nmi
- (f) Maximum reflectivity in dBZ to the nearest integer
- (g) Height of the Maximum Reflectivity in kft to the nearest integer

Note: Storm cells which are new (i.e., lack history) shall indicate "NEW" in the Forecast Movement field.

18.3 Annotations

18.3.1 Alphanumeric

Standard Annotations

Total Number of Identified Storms

18.3.2 Special Symbols

Past positions of the storm will be shown as small (5-pixel diameter) white, filled circles and forecast positions as white plus (+) marks of similar size. The current position is a circle (7-pixel diameter) within which is an "X".

The past, current, and forecast position symbols are connected with white line segments.

18.4 Product Interaction

The graphic portion of the product including the tabular format is displayable as an overlay on all geographically based products.

18.5 Comments

All site Storm Cell Tracking/Forecast adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

19 HAIL INDEX (HI)

19.1 SS Description

"This product shall provide, for each storm cell identified by the Storm Cell Identification and Tracking algorithm, the Probability of Hail, the Probability of Severe Hail, and the Maximum Expected Hail Size. The hail probabilities and size shown for each storm cell shall be generated by the Hail Algorithm. This product shall be produced in a tabular format of alphanumeric values, as a stand alone graphic product, and in a format for generating graphic overlays to other products. This product shall include a standard set of annotations. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

19.2 Display Format

The Probabilities of Hail and Severe Hail are computed in 10% increments. The Maximum Expected Hail Size is calculated to the nearest 0.25 inch.

19.2.1 Graphic Display

The product is displayable in full- or quarter-screen formats (See Appendix B, Formats I and II).

19.2.1.1 Data Display

If the Probability of Hail and/or the Probability of Severe Hail for a storm cell meet minimum display adaptable parameters, then a Hail Symbol (see Appendix A, I(A)(6) is placed immediately to the right of the storm cell ID. That position will be 19 pixels to the right and 2 pixels down from the storm cell centroid location. As a graphic overlay to other products, the hail symbol flashes and only the overlay portion of this product is displayed. The operator has the option to stop the flashing of the hail symbol. No hail symbol is displayed if the Probability of Severe Hail and the Probability of Hail are 0%.

The Maximum Expected Hail Size is also displayed in the middle of the Hail Symbol in white to the nearest inch. In this display, if the Maximum Expected Hail Size is less than 0.75 inches, an asterisk will be displayed, and if the size is greater than 4 inches, "4" inches will be displayed.

19.2.1.2 Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x deg)	Product Center
0 to 124	N/A	N/A

19.2.1.3 Graphic Overlay

As a graphic overlay to other products, only the overlay portion of the graphic display product and the attribute table is displayed.

19.2.2 Alphanumeric

19.2.2.1 Alphanumeric Display

In the alphanumeric product (tabular format for the alphanumeric screen), the Hail Attribute Table (see Appendix B, format III, configuration 4), and the combined Attribute Table (see Appendix B, Format III, configuration 5), the following apply: if the Probability of Severe Hail and the Probability of Hail are 0%, then "0.00" inches is displayed; if the Probability of Severe Hail and the Probability of Hail are greater than 0% and the Maximum Expected Hail Size is less than 0.50 inches, then "<0.50" inches is displayed; if the Maximum Expected Hail Size is greater than 4.00 inches, then the value ">4.00" inches is displayed; if the hail characteristics can not be determined (e.g. storm cell is beyond 124 nmi range) the hail characteristics are labeled 'UNKNOWN'.

By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the UCP operator has the capability to limit the number of storm cells included in this format from 10 to 100.

19.2.2.2 Alphanumeric Screen

The tabular format, displayed on the alphanumeric screen (i.e. the Hail alphanumeric product), includes up to an adaptable number of storm cells identified by the Storm Cell Centroids Algorithm. The format used is specified in Appendix C.

- (a) Storm Cell ID
- (b) Probability of Severe Hail in percentage
- (c) Probability of Hail in percentage
- (d) Maximum Expected Hail Size in inches
- (e) Adaptable Hail Parameters

19.2.2.3 Graphic Screen

The tabular format, displayed on the graphic screen (i.e. the Hail Attribute Table) includes all storm cells identified by the Storm Cell Centroids Algorithm. The format used is specified in Appendix B, Format III, Configuration 4.

- (a) Storm Cell ID
- (b) Current Storm Position in (AZRAN) degrees and nmi to the nearest integer from the RDA
- (c) Probability of Severe Hail in percentage
- (d) Probability of hail in percentage
- (e) Maximum Expected hail Size in inches
- (f) Altitude of 0°C and -20°C environmental temperatures in kft (from adaptation data)
- (g) Time and Date of the last change to the Hail Temperature Altitudes

19.3 Annotations

19.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))

19.3.2 Special Symbols

The hail symbol is a green isosceles triangle. The triangle can be small (a base of 8 pixels and a height of 12 pixels) or large (a base of 16 pixels and a height of 20 pixels). The size of the triangle and whether the triangle is filled depends upon the Probability of Severe Hail and the Probability of Hail. The following are the rules of display and default settings.

Triangle	Prob. Of Svr. Hail	Prob. Of Hail
Large/Filled	$\geq 50\%$	N/A
Large/Open	$\geq 30\%$	N/A
Small/Filled	0%	$\geq 50\%$
Small/Open	0%	$\geq 30\%$

However, the probabilities are adaptable parameters at the PUP alphanumeric terminal, and the user has the ability to disable the display of one or both of the small and/or large triangles. The Maximum Expected Hail Size will be displayed in the middle of the triangle.

19.4 Product Interaction

The graphic portion of the product including the tabular format is displayable as an overlay to all geographically based products.

19.5 Comments

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

When ranking of storm cells by hail characteristics, storm cells labeled 'UNKNOWN' are considered of lower rank than those with a Probability of Severe Hail of 0% and a Probability of Hail of 0%.

20 MESOCYCLONE (M, MRU, MD, DMD)

20.1 SS Product Description

"The Mesocyclone (M) product shall provide information about identified shear and mesocyclone features. This product shall be generated from the output of the Legacy Mesocyclone Detection Algorithm. This product shall be generated in a format that can be used to generate an alphanumeric tabular display for an identified feature or all simultaneously, a graphic display or a graphic overlay to other products. This product shall be updated once per volume scan time. If on a particular volume scan there is no output from the Legacy Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, radar position, radar elevation above MSL, and radar operational mode. Upon user request, all site adaptable parameters identified as input to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

"A Mesocyclone Rapid Update (MRU) version of this product shall be generated once per elevation scan time to provide updated Legacy Mesocyclone Detection Algorithm information. Current Legacy Mesocyclone Algorithm data at an elevation scan shall be based on the elevations that have been completed thus far in the current volume scan. This information shall be combined with Mesocyclone and Storm Track Algorithm information from the previous volume scan to form the MRU product.

The average motion of all SCIT storm cells from the previous volume scan shall be used to derive a forecast position of each previous feature at the current volume scan time. In feature type order, the forecast position of each feature from the previous volume scan shall be matched to the closest feature from the current volume scan, within a search radius defined by SCIT algorithm adaptation data. Current 3D features which are not matched to a feature from the previous volume scan, shall be assigned the status of New. If previous volume scan data are unavailable, all features shall be reported as new. Current features shall inherit the attributes of the matched previous feature (associated storm ID, feature type, maximum tangential shear, height of maximum tangential shear, top height, base azimuth, base range, base height, azimuth diameter, range diameter).

The position attributes (base azimuth, range, and height) of a previous feature matched to a current feature shall be updated to the current detection. If the top height of the matched feature is higher, the feature top height shall be updated. The position attributes of a previous feature not matched to a current feature, shall be set to the extrapolated forecast position. The status of unmatched previous features shall be assigned to Extrapolated. Strength attributes shall be updated if they increase in magnitude.

The strength attributes are feature type and maximum tangential shear. If the maximum tangential shear is updated, the radial and azimuthal diameters and the height of the maximum tangential shear shall also be updated. Features with increasing strength attributes shall be assigned the status of Increasing. All other matched features shall be assigned the status of Persistent. Attribute data updated with current volume data shall be identified. At the end of the volume scan extrapolated features shall be removed.

This product shall be generated in a format that can be used to generate an alphanumeric tabular display, a graphic display or a graphic overlay to other products. On alphanumeric displays, the status (Persistent, Increasing, New, or Extrapolated) of each feature status shall be reported. In the

graphic symbol display, features status shall be reported as either extrapolated or current. Current features include all features with a status of Increasing, Persistent, or New. If on a particular elevation scan there is no output (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode."

"The MD version of this product shall provide information about circulation features generated from the output of the new Mesocyclone Detection Algorithm. This product shall provide information concerning the past and future positions of each tracked circulation feature. This product shall be generated in a format that can be used to generate an alphanumeric tabular display for an identified feature or all simultaneously, a graphic display or a graphic overlay to other products. This product shall be updated once per volume scan time. If on a particular volume scan there is no output from the Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, radar position, radar elevation above MSL, and radar operational mode."

The DMD version of this product shall be generated to support generation of interactive user displays at an external system (e.g., AWIPS). This product shall be updated once per elevation scan time. The end-of-volume edition shall contain complete algorithm data for the volume scan. The elevation editions shall contain the algorithm data which has been updated since the previous volume edition product. A detection status shall be reported for circulation features that are topped or extrapolated. If on a particular elevation scan there is no output from the Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode.

20.2 Display Format

20.2.1 Graphic Display

The products are displayable in full- or quarter-screen format (see Appendix C).

20.2.1.1 Data Display

The mesocyclone or 3D correlated shear symbol will be placed directly over the position of the mesocyclone or shear at the lowest elevation scan in which it was detected. For the MRU product: extrapolated mesocyclone and 3D correlated shear features will be displayed centered on the forecasted position at the lowest elevation scan it was previously detected; mesocyclone and 3D correlated shear features detected in the current volume scan will be displayed centered on the position of the matched current feature at the lowest angle in which it is detected. See also Appendix A, I(B)(4).

For the MD version, the graphic display will contain up to 100 MDA detected features, sorted first by strength rank, then by Mesocyclone Strength Index (MSI). The number of features in the product can be reduced by raising the minimum display filter rank and/or the overlap filter, both MDA adaptable parameters.

When sufficient data are available, the past positions of each feature for each volume scan (up to 10 past volume scans) will be shown along with the current position and up to six future positions (at 5

minute intervals). The past positions will be displayed at the lowest elevation each MDA feature was detected. MDA tracks will consist of past, current and forecast positions connected by linear segments with a width of one pixel. The operator at the external display system (e.g., AWIPS) will have the ability to select whether to display the past and/or forecast tracks and positions and feature IDs.

In the event an identified MDA feature forecast speed is less than 2.5 m/s the feature motion is considered stationary. For stationary MDA features, a single past position will be reported at the current feature center.

20.2.1.2 Range/Data Resolution

Coverage Area	Resolution (<u>nmi</u>)	Product Center
(<u>nmi radius</u>)	<u>x nmi</u>	
0 to 124	N/A	Radar location

20.2.1.3 Graphic Overlay

As a graphic overlay to other products, it will be possible to display only the image portion of this product; that is, the screen right area annotations will not be displayed when the product is used as an overlay. Each mesocyclone will be identified with the associated storm ID in white. In overlay form, the mesocyclone and 3D shear symbol have pixel priority over all but the TVS symbol. The mesocyclone and 3D shear symbols, which are displayed in yellow, flash when displayed as overlays. The operator will have the option to stop the flashing of the mesocyclone symbol.

For the MRU version, the AWIPS operator will have the option to turn off display of extrapolated features.

For the MD version, circulations strong enough to be classified as mesocyclones will be identified with the Circulation ID (0 to 999) displayed next to the mesocyclone symbol.

20.2.2 Alphanumeric Display

An alphanumeric tabular product version is generated for display on the alphanumeric display. The format to be used is defined in Appendix C.

With the following exceptions, the format of the MRU graphic attribute and alphanumeric tabular portions of the product will follow the non-rapid update Mesocyclone product: feature status will be reported as EXT, PER, INC, and, NEW to denote extrapolated, persistent, increasing, and new features, respectively; and the character ^ (hexadecimal value 5E) will be placed next to data which was computed from current volume scan detections. The format to be used is defined in Appendix B and C.

For the MD version, up to 100 features will be listed from highest to lowest strength rank with Mesocyclone Strength Index (MSI) as a secondary order (highest MSI to lowest MSI).

Except for those parameters indicated with an asterisk above, the elevation edition will contain only parameters updated since the previous volume. A complete time history of MDA information for a feature is available from a collection of DMD volume editions along with the latest DMD elevation edition. All data for an on-going feature can be linked by its Meso ID parameter that remains constant through out the life time of a feature.

20.2.3 DMD Format for External Systems

The DMD product is a rapid update implementation of the MDA, meaning that after each elevation cut of the current volume scan, algorithm output is available to update any MDA results from the previous volume scan. Therefore, it is important to distinguish between products with the Last Elevation Flag set (i.e. a volume edition) and those without the Last Elevation Flag set (i.e. an elevation edition). A volume edition, will contain complete MDA information for the volume scan. For the volume edition, the parameters listed below are included for all detected MDA features meeting a minimum strength rank of 1 (up to a maximum of 100 features):

As specified in Figure 3-15b, Note 1, of the *RPG To Class 1 User ICD*, the DMD product is encoded using an API available from the Radar Operations Center. This API also provides functions for those wishing to decode a DMD product, as well as extract product parameters and feature parameters. The DMD product contains up to 100 MDA detected circulation features. All DMD products contain the following three DMD Product Parameters:

DMD Format for External Systems

DMD Product Parameters (One parameter per DMD product)	Units ; Precision or Values
Average Direction of Tracked Features	deg ; 0.1
Average Speed of Tracked Features	m/s ; 0.1
Last Elevation Flag	Values = 0 or 1 if last elevation

MDA Feature Parameters (One parameter per MDA detected circulation)	Units ; Precision or Values
Meso ID*	na ; 1
Detection Status*	Values = "TOP", "EXT", " " " "
Base Azimuth*	deg ; 0.1
Base Range*	km ; 0.1
Age	s ; 1
Strength Rank	na ; 1
Strength Rank Type	Values = ' ', 'L' or 'S'
MSI	na ; 1
Base Diameter	km ; 0.1
Base Height	km ; 0.1
Depth	km ; 0.1
Storm Relative Depth	percent ; 1
Base Gate-to-Gate Velocity Difference	m/s ; 0.1
Base Shear	m/s/km ; 0.1
Base Rotational Velocity	m/s ; 0.1
Max Rotational Velocity	m/s ; 0.1
Height of Max Rotational Velocity	km ; 0.1
Max Shear	m/s/km ; 0.1
Height of Max Shear	km ; 0.1
0-2 km ARL Convergence	m/s ; 0.1
2-4 km ARL Convergence	m/s ; 0.1
Associated TVS	Values = 'Y', 'N' or 'U'
Associated Storm ID	Values = "A0" through "Z9"
Overlaps Lower Feature	Values = "Y" or "N"
Base on Lowest Elevation	Values = "Y" or "N"
Direction	deg ; 0.1
Speed	m/s ; 0.1
# Past Positions	na ; 1
Past Latitude Position (array)	deg; 0.0001
Past Longitude Position (array)	deg; 0.0001
# Forecast Positions	na ; 1
Forecast Latitude Position (array)	deg; 0.0001
Forecast Longitude Position (array)	deg; 0.0001
Number of 2D Features in this 3D Feature	na ; 1
Elevation Time (array)	s ; 1
2D Height (array)	km ; 0.1
2D Diameter (array)	km ; 1
2D Gate-to-Gate Velocity Difference (array)	m/s ; 1
2D Shear (array)	m/s/km ; 1
2D Rotational Velocity (array)	m/s ; 1
2D Strength Rank (array)	na ; 1

* Always included for all features

20.3 Annotations

20.3.1 Alphanumeric

Standard annotations

Site Adaptable Parameters for the legacy version

Elevation angle for the MRU version

All annotations (except for Radar position) with the alphanumeric product format will be included in the message.

20.3.2 Special Symbols

The mesocyclone will be displayed (centered on the location of the mesocyclone at the lowest elevation angle in which it is detected) as a yellow open circle, whose perimeter is 4 pixels thick. The size of the symbol will be proportional to the average of the mesocyclone radial and azimuthal diameters. The minimum size symbol will be a circle having a diameter of 14 pixels.

The 3D correlated shear will be displayed as a yellow open circle, 1 pixel thick and is centered (similarly to the mesocyclone) on the 3D shear center at the lowest elevation angle at which it was detected. The size will be proportional to the average diameter. The minimum size symbol will be a circle having a diameter of 14 pixels.

For the MRU version, AWIPS will distinguish between the Mesocyclone and 3D correlated shear features will by the thickness of the perimeter of a circle (i.e., thick perimeter is a Mesocyclone and thin for 3D Correlated Shear). In addition, AWIPS will distinguish between current (new, persistent, and increasing) and extrapolated (unmatched) 3D features by the line style of the circle perimeter (i.e., traditional AWIPS mesocyclone and 3D Correlated shear symbols are used for current features, but symbols with a dashed perimeter are used for extrapolated features).

For the MD version, features having a strength rank 5 or higher will be displayed similar to the legacy Mesocyclone symbol. In addition, if the feature's base was detected on the lowest elevation angle, or its base height was at or below 1 kilometer, the Mesocyclone symbol will contain outward spikes. For MDA features having a strength rank less than 5, the symbol will be similar to the legacy 3D correlated shear symbol. The size of the symbol will be drawn to scale with the base level feature diameter.

The MDA track consists of past, current, and forecast feature positions connected by linear segments one pixel wide. Past positions will be displayed as yellow filled diamond. Forecast positions will be displayed as yellow x cross signs, of similar size.

20.4 Product Interaction

This product is displayable as an overlay on all geographically based products. For the MRU version, the AWIPS operator will be provided the option to choose between displaying the latest elevation (i.e., highest elevation) and displaying a specific elevation; when the latest elevation is selected, the display will automatically update when higher elevation products are received.

20.5 Comments

All site adaptable parameters identified as inputs to the algorithm used to generate data for this product will be available for display at the applications terminal upon user request. See 12.8 for the format description.

The current value of the three MDA adaptable parameters will be placed in a corner of the graphic overlay display. If there are no features, the text “No Circulations” will be placed on the graphic display

21 TORNADO VORTEX SIGNATURE (TVS)

21.1 SS Product Description

"This product shall provide information regarding the existence and location of an identified Tornado Vortex Signature (TVS). This product shall be produced from the output of the Tornado Detection Algorithm. The product shall produce an alphanumeric tabular display and a graphic overlay of the algorithm output data for each identified TVS (and Elevated TVS (ETVS)) signature information when such is identified. This product shall be updated once per volume scan time. This product shall include annotations for the product name, radar ID, time and date of volume scan, radar position, radar elevation above MSL, and radar operational mode. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

"A Tornado Vortex Signature Rapid Update (TRU) version of this product shall be generated once per elevation scan time to provide updated Tornado Detection Algorithm (TDA) information. Current Tornado Detection Algorithm data at an elevation scan shall be based on the elevations that have been completed thus far in the current volume scan. This information shall be combined with TDA, MDA, and Storm Track Algorithm information from the previous volume scan to form the TRU product.

The average motion of all tracked MDA features from the previous volume scan shall be used to derive a forecast position of each TDA feature from the previous volume scan at the current volume scan time. If the average motion from MDA is unavailable, the average motion of all SCIT storm cells from the previous volume scan shall be used. In priority rank order, the forecast position of each feature from the previous volume scan shall be matched to the closest feature from the current volume scan, within a search radius defined by SCIT algorithm adaptation data.

Priority rank order places TVS types before ETVSs, and within each type features are ordered by Low-level Delta Velocity, from greatest to least. Current TVS/ETVS features which are not matched to a feature from the previous volume scan, shall be assigned the status of New. If previous volume scan data are unavailable, all features shall be reported as New. Current features shall inherit the attributes of the matched previous feature (associated storm ID, feature type, low-level delta velocity, maximum delta velocity and its height, average delta velocity, maximum shear and its height, base and top heights, depth, and base azimuth and range).

The position attributes (base azimuth, range, and height) of a previous feature matched to a current feature shall be updated to the current detection. The position attributes of a previous feature not matched to a current feature, shall be set to the extrapolated forecast position (base azimuth and range only). The status of unmatched previous features shall be assigned to Extrapolated.

Strength attributes of a previous feature matched to a current feature shall be updated if they increase in magnitude. The strength attributes are feature type, low-level delta velocity, and depth. The attributes maximum delta velocity, maximum shear, and average delta velocity are also updated to the current value if they increase in magnitude, but their increase will not trigger a status change to Increasing. If the maximum delta velocity and maximum shear are updated, their heights shall also be updated. Features with increasing strength attributes shall be assigned the status of Increasing. All other matched features shall be assigned the status of Persistent.

Attribute data updated from current volume data shall be identified. At the end of the volume scan, the extrapolated features shall be removed. This product shall be generated in a format that can be used to generate an alphanumeric tabular display, a graphic display or a graphic overlay to other products. In each type of display, features shall appear in priority rank order. On alphanumeric displays, the status (Persistent, Increasing, New, or Extrapolated) of each feature status shall be reported.

In the graphic symbol display, features status shall be reported as either extrapolated or current. Current features include all features with a status of Increasing, Persistent, or New. If on a particular elevation scan there is no output (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode.”

21.2 Display Format

The product has three parts. Geographic and alphanumeric table parts are displayable on the graphic screen. And the alphanumeric table is displayable on the alphanumeric screen. For all three parts, data (described below) will be provided for all detected TVSs and Elevated TVS (ETVS). By default, a maximum of 15 TVSs and 20 ETVSs are detectable; however, these numbers are adaptable at the UCP up to values of 25 TVSs and 25 ETVSs.

Each TVS (and ETVS) is associated with the nearest storm cell within an UCP adaptable distance. If the TVS (or ETVS) is not associated with a storm cell, "??" will be displayed as the Storm Cell ID. With the following exceptions, the format of the TRU graphic attribute and alphanumeric tabular portions of the product will follow the non-rapid update TVS product: feature status will be reported as EXT, PER, INC, and, NEW to denote extrapolated, persistent, increasing, and new features, respectively; and the character ^ (hexadecimal value 5E) will be placed next to data which was computed from current volume scan detections. The format to be used is defined in Appendix B and C.

21.2.1 Graphic Screen

These parts of the product are displayable concurrently as an overlay on all geographically based products. As a graphic overlay to other products, it will be possible to display only the image portion of this product; that is, the screen right area annotations will not be displayed when the product is used as an overlay.

21.2.1.1 Geographic

The graphic display consists of the TVS and ETVS symbols (see Section 21.3.2) The symbols are placed such that the apex of the triangle is centered on the geographic position of the TVS (or ETVS) at the lowest elevation angle where it is found. For the TRU product: extrapolated TVS and ETVS features will be displayed centered on the forecasted position at the lowest elevation scan it was previously detected; TVS and ETVS features detected in the current volume scan will be displayed centered on the position of the matched current feature at the lowest angle in which it is detected.

The symbols flash when displayed as an overlay. The operator will have the option to stop the flashing. Along with each TVS (and ETVS), the Storm Cell ID (see Section 18.2) is displayed in white (Code: FF FF FF) 5 pixels to the right and 5 pixels down from the location of the storm cell centroid. This part of the product is displayable in full- and quarter-screen formats (see Appendix B).

The PUP operator will have the ability through a one level password protected menu at the Alphanumeric Terminal to select whether to display the symbols for only TVSs or both TVSs and ETVSs. The default will be to only display TVS symbols. For the TRU version on the AWIPS the following applies: the operator will have the option to turn off display of extrapolated features; the operator will be provided the option to choose between displaying the latest elevation (i.e., highest elevation) or displaying a specific elevation; when the latest elevation is selected, the display will automatically update when higher elevation products are received.

21.2.1.1.1 Range/Data Resolution

Coverage Area	Resolution (<u>nmi</u>)	Product
(<u>nmi radius</u>)	<u>x nmi</u>	Center
0 to 124	N/A	Radar Location

21.2.1.2 Alphanumeric Table

A tabular format is displayable on the graphic screen (i.e. the TVS Attribute Table). The format used is specified in Appendix B, Format III, Configuration 3 and includes the following information about all TVSs and ETVSs.

- (a) TYPE - TVS or ETVS
- (b) STORM ID - ID of the closest associated Storm Cell
- (c) AZ/RAN - Azimuth and range in degrees and nmi to the nearest integer.
- (d) AVGDV - Average Delta Velocity in knots to the nearest integer
- (e) LLDV - Low-level (base) Delta Velocity in knots to the nearest integer
- (f) MDV - Maximum Delta Velocity in knots to the nearest integer
- (g) BASE - Base height (of the signature) in kft to the nearest tenths
- (h) DPTH - Depth (of the signature) in kft to the nearest integer

TVSs are listed before ETVSs, and both types are ranked by their Low-level Delta Velocity (from greatest to least). (NOTE: If the base is detected on the lowest elevation scan of the volume scan, then the BASE (height) is qualified with '<' respectively. And, if either the base or top are detected on the lowest or highest elevation scan of the volume scan, then the DPTH is also qualified with a '>'.) A brief description of this format can also be found in Appendix A, II(4).

21.2.2 Alphanumeric Screen

A tabular format is displayable on the alphanumeric screen (i.e. the TVS alphanumeric product). The format used is specified in Appendix C and includes the following information about all TVSs and ETVSs (up to an adaptable number):

- (a) Feat Type - Feature Type, TVS or ETVS
- (b) Feat ID - Feature ID (or number)
- (c) Storm ID - Storm Cell ID
- (d) AZ/RAN - Azimuth and range in degrees and nmi to the nearest integer
- (e) AVGDV - Average Delta Velocity in knots to the nearest integer
- (f) LLDV - Low-level (base) Delta Velocity in knots to the nearest integer
- (g) MXDV/Hgt - Maximum Delta Velocity in knots to the nearest integer and the Height in kft to the nearest tenths
- (h) Depth - Depth (of the signature) in kft to the nearest tenths
- (i) Base/Top - Base and Top (of the signature) in kft to the nearest tenths
- (j) MXSHR/Hgt - Maximum Shear in m/s/km to the nearest integer and Height in kft to the nearest tenths

TVSs are listed before ETVSs, and both types are ranked by their Low-level Delta Velocity (from greatest to least). (NOTE: If the base or top are detected on the lowest or highest elevation scan of the volume scan, respectively, then the Base/Top (height(s)) is qualified with '<' or '>', respectively. And, if either the base or top are detected on the lowest or highest elevation scan of the volume scan, then the Depth is also qualified with a '>'.) In addition, this part of the product includes all TDA adaptable parameters. The adaptable parameters are formatted in a tabular layout showing the parameter name in one column and the value and units in an adjacent column.

21.3 Annotations

If the TDA found more than the (adaptable) maximum number of TVSs or ETVSs, then the number of TVSs or ETVSs (as appropriate) in the Annotations will be preceded by a '>'.

21.3.1 Graphic Screen

Standard Annotations (Appendix A,I(A))
Number of TVSs and ETVSs
Elevation angle for the TRU version

21.3.2 Alphanumeric Screen

Product Specification
Standard Units and Abbreviations,
Product Name
Date/time of volume scan
RDA ID
Elevation angle for the TRU version
Number of TVSs and ETVSs

21.4 Special Symbols

The symbol for a TVS is a red (code: FF 00 00) filled inverted isosceles triangle, and the symbol for an ETVS is the same except it is unfilled (i.e. only a red triangle outline). The triangle has a base of 10 pixels and a height of 14 pixels. For the TRU version on the AWIPS, extrapolated (unmatched) TVS and ETVS features will be distinguished (less prominent symbols) from current (new, persistent, and increasing) features (normal TVS and ETVS symbols).

22 STORM STRUCTURE (SS)

22.1 SS Product Description

"This product shall provide, for each identified storm cell, information regarding the structure of the storm cell. This product shall be produced from and contain the values that are output by the Storm Cell Centroids Algorithm. This product shall be updated once per volume scan time. This product shall be produced in a tabular alphanumeric format and shall include annotations for the product name, radar ID, time and date of volume scan, and the total number of identified storm cells. Upon user request, all site adaptable parameters identified as inputs to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

22.2 Display Format

22.2.1 Graphic Display

This product does not have a graphic component. However, Trend data is available with this product. The contents and format of the Trend Data are delineated in packet codes 21 and 22 of the Interface Control Document for RPG/Associated PUP (2620001).

22.2.2 Alphanumeric Display

This product is displayable only on the applications terminal in tabular alphanumeric format (see Appendix C). The alphanumeric tabular format, displayed on the alphanumeric screen includes the following information for up to an adaptable number of storm cells identified by the Storm Cell Centroids Algorithm.

- (a) Storm Cell ID
- (b) Current Storm Position in (AZRAN) degrees and nmi to the nearest integer from the RDA
- (c) Storm base in kft
- (d) Storm top in kft
- (e) Cell Based VIL in kg/m²
- (f) Maximum Reflectivity in dBZ
- (g) Height of Maximum Reflectivity in kft
- (h) Number of Storm Cells
- (i) Adaptable Parameters for all SCIT algorithms

By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the UCP operator has the capability to limit the number of storm cells included in this format from 10 to 100.

22.2.2.1 Range/Data Resolution

Coverage Area	Resolution (<u>nmi</u>	Product
(<u>nmi radius</u>)	<u>x nmi</u>)	Center
0 to 248	N/A	Radar location

22.3 Annotations

22.3.1 Alphanumeric

Standard annotations (Appendix A, I(A))
Number of Storms detected

22.3.2 Special Symbols

None defined

22.4 Product Interaction

None

22.5 Comments

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

23 LAYER COMPOSITE REFLECTIVITY (LRM, LRA, APR)

23.1 SS Product Description

"Each product shall contain annotations for product name, radar ID, date and time of volume scan, maximum data value detected, radar position, radar elevation above MSL, and radar operational mode. All layer products shall be on a geographically based Cartesian grid, centered on the radar. Up to three layers shall be available for layer products at each site; the depth of each layer shall be controlled via adaptation data. The exception to this is the Layer Composite Reflectivity - Anomalous Propagation Removed (APR) product which consists of one layer, and that layer has the same layer boundaries as the lowest layer of the Layer Composite Reflectivity product. The default values are listed in SS, Table E-1. No layer will be less than 6,000 ft thick. Each layer product shall be updated on a volume scan basis.

Eight data levels shall be available for each product, including one for data below minimum threshold and one for no data. The default values for the reflectivity shall be standard NWS DVIP levels, as defined in FMH 7. The data level thresholds shall be controlled via adaptation data. Before layering, the reflectivity data shall be thresholded with respect to mean noise level and shall also be filtered to remove spurious isolated data caused by point targets. It shall be possible to select either a maximum value or the average reflectivity for the grid box, but not both simultaneously. The range of coverage for each product shall be controlled via adaptation data; the default is a 460-km x 460-km square centered on the radar.

For the APR product, a clutter editor is applied to the reflectivity data (using both velocity and spectrum width data as inputs) to remove clutter contaminated data. This product displays the maximum value for each grid box. The range of coverage for this product is fixed as a 460-km x 460-km squared centered on the radar.

A three-dimension (3-D) grid box shall be defined as the vertical projection of the geographically based Cartesian grid square through the appropriate layer. All radar resolution volumes whose centers are contained in a given 3-D grid box shall be included in the computation for the 3-D grid box. All 3-D boxes whose centers fall in a radar resolution volume shall include the radar resolution volume in the computation for that 3-D grid box. A center that falls on a boundary shall be considered to fall on both/all sides of the boundary. The product resolution shall be 4 km by 4 km. The use of look-up tables for computational efficiency is permitted. To facilitate this, off-line processing may be used to generate new look-up tables whenever adaptation parameters are changed or new scanning sequences are added to the system."

23.2 Display Format

The product is displayable in full- or quarter-screen format (see Appendix B).

23.2.1 Data Levels

The reflectivity data levels will vary as specified in adaptation data.

23.2.2 Color Level Code Tables

The color level code used for display will default to the NWS DVIP values specified in FMH 7. However, other levels may be substituted via adaptation data. The currently defined color code is listed.

			Color Levels	
8-Level Code	Display dBZ	Range dBZ	Code	Color
0	ND	SNR<TH or dBZ<5	(00 00 00)	black
1	5	5≤dBZ<18	(FF AA AA)	light pink
2	18	18≤dBZ<30	(C9 70 70)	dark pink
3	30	30≤dBZ<41	(00 BB 00)	medium green
4	41	41≤dBZ<46	(FF FF 70)	light yellow
5	46	46≤dBZ<50	(DA 00 00)	medium red
6	50	50≤dBZ<57	(00 00 FF)	blue
7	57	57≤dBZ	(FF FF FF)	white

23.2.3 Range/Data Resolution

Layer	Coverage Area (nmi x nmi)	Resolution (nmi x nmi)	Product Center
(APR product) SFC to 24,000 ft above MSL	248 x 248	2.2 x 2.2	Radar location
(Lowest LRM and LRA) Site adaptable to 24,000 ft above MSL same coverage area, resolution and product center	248 x 248	2.2 x 2.2	Radar location
(LRM and LRA products only)	248 x 248	2.2 x 2.2	Radar location
24,000 ft to 33,000 ft above MSL			
33,000 ft to 60,000 ft above MSL	248 x 248	2.2 x 2.2	Radar location

Note: Other coverage areas may be specified via adaptation data.

23.3 Annotations

23.3.1 Alphanumeric

Standard Annotation (Appendix A, I(A))
Maximum Data Value Detected
Layer Boundary (vertical depth)
Maximum (LRM, APR) or Layer Average Reflectivity (LRA) Displayed
Data Level Code

23.3.2 Special Symbols

None defined

23.4 Product Interaction

The following overlay products are displayable on this product:

- Hail
- Mesocyclone
- Severe Weather Probability
- Storm Track Information
- Tornado Vortex Signature.

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24 DELETED

25 USER ALERT MESSAGE (UAM)

25.1 SS Product Description

"This product shall provide a brief message defining an area of indicated severe weather. The message shall contain the location, type and severity of the weather event, and storm speed and direction of movement. The product shall be updated once per volume scan. The product shall include annotations for the product name, radar ID, time and date of scan, radar position, radar elevation above MSL, and severe weather information as appropriate."

25.2 Display Format

UAM	NNN	HH:MM	MM/DD/YY
	(RDA ID)	(HOUR:MINUTES)	
	(MONTH/DAY/YEAR)		

Alert Area(1 or 2)

Position (see note 1) Azimuth XXX.X DEG

Range XXX.X NM

Alert Category XXXXXXXXXXXXXXXXXX (see Table IV of 2620001)

Threshold (Operator Selected Value and units)

Exceeding (Alert Triggering Value and units)

Storm Cell ID XX STORM MOTION XXX/XXX DEG/KTS.

25.3 Annotations

25.3.1 Alphanumeric

Standard Annotations

Location of Alerting Phenomena

Severe Weather Information as appropriate

25.3.2 Special Symbols

None defined.

Note 1:Position is the alert grid box center for grid base alerts, features base center for mesocyclone and TVS alerts, not applicable for VAD and One Hour rainfall alerts, and Storm cells centroid for all other alerts.

26 RADAR CODED MESSAGE (RCM)

26.1 SS Product Description

"The Radar Coded Message (RCM) shall be produced in accordance with, SS, 2810000A, Appendix K and made available from the RPG.

The pre-edit stage of Part A shall contain an intermediate graphic product and a tabular listing of alphanumerics. The intermediate graphic product shall contain reflectivity data for the 1/16 LFM grid over the radar area of coverage out to 460 km. The reflectivity intensity value for each grid box shall be determined by assigning the maximum value of all Reflectivity boxes whose centers are contained within the 1/16 LFM grid square.

The intermediate graphic product shall be based on the 256 level, 1 km x 1 degree Composite and Hybrid Scan Reflectivity Products but contains only 9 data categories: 6 for data within 230 km, 1 for missing or below threshold data, and 2 for data beyond 230 km. Hybrid Scan Reflectivity data (output by the ENHANCED PRECIPITATION PREPROCESSING ALGORITHM) shall be used for the region within 230 km of the radar and Composite Reflectivity data shall be used for the region outside of 230 km. The selection of which reflectivity levels map into which of the six radar coded message categories shall be adaptable at the UCP. For data beyond 230 km, a separate adaptable threshold shall be provided for which:

- (a) all data above that threshold will be labeled as category 8, and
- (b) all data below that threshold will be labeled as category 9.

The intermediate graphic product shall be presented to the user at the PUP for graphic editing by deleting data or changing data to another data level within areas outlined by using the cursor control device. Each area shall be a variable-sized polygon of up to 20 sides. Other normal PUP functions such as magnify and cursor linking shall be available during the edit procedure.

A readout of the location of the cursor control device shall be provided to indicate the 3-letter designation of the 1/16 LFM grid box. This readout shall be displayed continuously while using this product and be updated at least once per second. The alphanumeric list shall contain the height (MSL) and position of the maximum echo top. The height and the position where provided shall be derived from the Echo Tops Product. The alphanumeric list shall also include the location of the centroids with the largest Cell-based VIL within 230 km of the radar. The number of centroids reported shall be UCP adaptable from 0-20 with a default value of 12. Locations of these centroids shall be provided graphically by overlaying their respective storm identifiers on the intermediate graphic product.

As available from the output of the Storm Position Forecast Algorithm, the forecast centroid speed and direction shall also be listed. The capability to manually edit these alphanumerics shall be provided. When the user deletes an area during a graphic editing session, the centroids contained in those areas and the associated alphanumerics shall be automatically deleted. After editing, the graphics and alphanumerics shall be formatted into part A of the radar coded message.

Part B of the radar coded message shall contain a single profile of the horizontal wind information derived from the output of the VAD algorithm. The capability to edit these alphanumerics shall be provided.

Part C of this product shall contain remarks in an alphanumeric format. These remarks shall consist of both meteorological-algorithm-derived information and manually encoded remarks. The algorithm-derived information shall give the position of each detected mesocyclone or uncorrelated shear feature (as derived from the Mesocyclone Detection Algorithm) and each detected TVS (as provided by the TVS Algorithm). In addition, for each centroid included in Part A, Part C shall contain the Hail Index (as provided by the Hail Algorithm), and the Storm Tops information (as provided by the Storm Cell Centroids Algorithm). The capability for entry of formatted remarks shall be designed to minimize format errors and the manual entry and editing time. (The use of input assists such as on-screen menus, templates with defaults, and the use of the cursor control device for the LFM grid location input should be considered.) Unformatted remarks and the editor's initials shall be input through the keyboard. The capability to edit, add to, or restore the pre-edit alphanumeric text of Part C shall be provided.

After the editing opportunity, Parts A, B, and C shall be combined into a single message ready for transmission. The message code shall be as specified in Appendix K.

The RCM product shall be produced automatically up to 2 times per hour based on time of day specified at the UCP in minutes after the hour. This product shall also be produced upon one-time request from the designated RPGOP/PUP using data from the last completed volume scan. For a continually scanning radar, the product shall be produced from the last completed volume scan prior to the schedule time.

26.2 Display Format

26.2.1 A/N Message Format

The A/N message format for Parts A, B and C are outlined in Appendix D.

26.2.2 Graphic Display

The graphic display format is defined in Appendix B, Format VII. The display consists of the intermediate composite reflectivity upon which is superimposed on the LFM grid, storm IDs (up to 20, UCP adaptable number with 12 as the default), maximum dBZ and maximum echo tops value. The display also accommodates areas which display function selections, A/N intensity values for each grid box (Part A) and height, weather type and parameter selection menus for Part C editing.

26.2.3 Data Levels

The data levels* are UCP adaptable and consist of 9 (0 to 8) levels. Seven of the levels are for data within 124 nmi, six of the seven are for the data and one is for missing or below threshold. The remaining two levels of the nine are for the data beyond 124 nmi. The data levels beyond 124 nmi are processed based upon a second adaptable threshold value (TH2) which is defined as follows.

For all data beyond 124 nmi:

Level 7: $TH2 < dBZ$

Level 8: $TH \leq dBZ \leq TH2$; where TH is the threshold for the data within 124 nmi.

The following table defines the level and the corresponding data ranges.

9-Level Code	Display dBZ	Range dBZ	Color Levels	
			Code	Color
0	ND	$dBZ < 15$	(00 00 00)	black
1	15	$15 \leq dBZ < 30$	(00 FF FF)	cyan
2	30	$30 \leq dBZ < 40$	(FF 00 FF)	magenta
3	40	$40 \leq dBZ < 45$	(00 00 FF)	blue
4	45	$45 \leq dBZ < 50$	(32 00 96)	dark blue
5	50	$50 \leq dBZ < 55$	(FF FF 00)	yellow
6	55	$55 \leq dBZ$	(FF 00 00)	bright red
7	Data beyond 124 nmi that are above threshold 2			
8	Data beyond 124 nmi that are below threshold 2			

The numerical value of the TH2 will be displayed in the annotation.

26.2.4 Range/Data Resolution

Coverage Area (nmi)	Resolution*	Product Center
0 to 248	1/16 LFM	RDA

26.3 Annotations

26.3.1 Graphic

Standard annotations (Appendix A, I(A))

Data Level Code

Maximum data value of reflectivity

Maximum echo top

- - - - -

*Highest value mapped into grid out to 124 nmi; above/below a given threshold beyond 124 nmi to 248 nmi.

26.4 Product Interaction

The following overlay products are displayable on this product:

- Attribute Tables
- Hail
- Mesocyclone
- Severe Weather Probability
- Storm Track Information
- Tornado Vortex Signature.

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26.5 Comments

Normal product manipulation (magnify, filter, etc.) is available with the intermediate composite reflectivity (pre-edit RCM version only).

27 FREE TEXT MESSAGE (PTM, FTM)

27.1 SS Product Description

"This product shall provide a capability for defining an alphanumeric message for one-time transmission to specific NEXRAD Unit interface(s). The product shall be generated by an operator through the UCP or RPGOP for transmission to the RPG's users or by the PUP operator for transmission to the PUP's users. Messages may be designated to be transmitted to a specific or several NEXRAD Unit interfaces. Product shall include radar ID, date, and time that the message was completed."

27.2 Display Format

A prose style paragraphed statement or message

27.3 Annotations

Standard annotations as applicable

27.4 Product Interaction

None

28 SURFACE RAINFALL ACCUMULATION (OHP, THP)

28.1 SS Product Description

"These products shall provide 1-hour and 3-hour rainfall accumulation maps displayed as an image. The 1-hour map shall be updated every volume scan time and the 3-hour map shall be updated once per hour. These products shall be available for 16 accumulated precipitation data levels. Each product shall include annotations for the product name, radar ID, date and ending time (TSavgcur* or clock hour as appropriate) of the rainfall rate integration, maximum data value, radar position, radar elevation above MSL, radar operational mode, mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

28.2 Display Format

These products are displayable in full-screen format or quarter-screen format (see Appendix B).

28.2.1 Data Levels

The product will contain 16 data levels. The data level code may vary with operational mode and with NEXRAD (or agency) system adaptation data. The data thresholds are also site adaptable.

28.2.2 Color Level Code Table

			Color Levels	
16-Level Code	Display Inches	Range Inches	Code	Color
0	ND	in=0.0	(00 00 00)	black
1	>0.00	0.0<in<0.1	(AA AA AA)	gray
2	0.10	0.1≤in<0.25	(76 76 76)	dark gray
3	0.25	0.25≤in<0.5	(00 FF FF)	cyan
4	0.50	0.5≤in<.075	(00 AF AF)	dark cyan
5	0.75	0.75≤in<1.0	(00 FF 00)	green
6	1.00	1.0≤in<1.25	(00 8F 00)	dark green
7	1.25	1.25≤in<1.5	(FF 00 FF)	magenta
8	1.50	1.5≤in<1.75	(AF 32 7D)	dark magenta
9	1.75	1.75≤in<2.0	(00 00 FF)	blue
A	2.00	2.0≤in<2.5	(32 00 96)	dark blue
B	2.50	2.5≤in<3.0	(FF FF 00)	yellow
C	3.00	3.0≤in<4.0	(FF AA 00)	orange
D	4.00	4.0≤in<6.0	(FF 00 00)	bright red
E	6.00	6.0≤in<8.0	(AE 00 00)	dark red
F	8.00	8.0≤in	(FF FF FF)	white

*See Algorithm Report

28.2.3 Range/Data Resolution

The resolution of the graphic products is 1.1-nmi (range) by 1 deg (azimuth) out to a range of 124 nmi.

28.3 Annotations

28.3.1 Alphanumeric

Standard Annotations

Date and End Time of Rainfall Integration

Maximum Data Value

Radar Bias Estimate (mean bias for 3-hour product)

Effective G-R Pair Sample Size (mean for 3-hour product)

Missing Periods

Gage Adjustment Bias Flag

28.3.1.1 (OHP) Paired Alphanumeric

See Section 29.3.1.1 for complete list of adaptation data. [Note: THP paired alphanumeric product contains no adaptation data list.]

28.3.2 Special Symbols

None

28.4 Product Interaction

The following overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signature.

28.5 Comment

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

29 STORM TOTAL RAINFALL ACCUMULATION (STP AND DSP)

29.1 SS Product Description

"This product shall provide rainfall accumulation data, both displayed as an image and formatted as non-displayable, digital data. The product format and content of the image version (STP) shall be the same as the surface Rainfall Accumulation Product except the time period shall be a variable and shall equal the period of continuous rainfall in the radar area of coverage. This product shall include annotations for product name, radar ID, maximum data value detected, radar position, times and dates of the beginning and end (TSavgcur* or clock hour as appropriate) of the rainfall rate integration, radar position, radar elevation above MSL, radar operational mode, the mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

"The digital version of this product (DSP) shall be available for 256 data levels at each sample bin location of a 1 degree by 2 kilometer polar grid, extending to a range of 230 kilometers (124 nautical miles). The digital version is provided to support processing external to the NEXRAD system. It shall be updated every volume scan and will include the same annotations as the graphical version of the product (listed above)."

29.2 Display Format

The image version of this product is displayed in full-screen format or quarter-screen format (see Appendix B). It will be formatted as an image radial product. The digital version is non-displayable.

29.2.1 Data Levels

In the image version of the product, the storm total precipitation is displayed in 16 data levels. The data level code may vary with operational mode and with NEXRAD (or agency) system adaptation data. The data thresholds are site adaptable.

The digital version of the product will contain 256 data levels on an automatically- adjustable, linear scale based on the maximum storm accumulation . Level code 0 will correspond to no accumulation and level codes 1 through 255 will indicate accumulations, with a minimal step of .01 inches. For every multiple of 2.55 inches exceeded, the scale will increment by a corresponding integer multiple. That is, if the maximum accumulation exceeds 2.55 inches, the scale will become .02 inches; if the maximum exceeds 5.10 inches, the scale will become .03 inches, etc. The scale (as integer multiple of .01 inches) will be included in the product header.

The digital data will be compacted on a radial basis.

*See NEXRAD Algorithm Report

29.2.2 Color Level Code Tables (for the image version of the product):

			Color Levels	
16-Level <u>Code</u>	Display <u>Inches</u>	Range <u>Inches</u>	<u>Code</u>	Color
0	ND	$\text{in}=0.0$	(00 00 00)	black
1	>0.00	$0.0<\text{in}<0.3$	(AA AA AA)	gray
2	0.3	$0.3\leq\text{in}<0.6$	(76 76 76)	dark gray
3	0.6	$0.6\leq\text{in}<1.0$	(00 FF FF)	cyan
4	1.0	$1.0\leq\text{in}<1.5$	(00 AF AF)	dark cyan
5	1.5	$1.5\leq\text{in}<2.0$	(00 FF 00)	green
6	2.0	$2.0\leq\text{in}<2.5$	(00 8F 00)	dark green
7	2.5	$2.5\leq\text{in}<3.0$	(FF 00 FF)	magenta
8	3.0	$3.0\leq\text{in}<4.0$	(AF 32 7D)	dark magenta
9	4.0	$4.0\leq\text{in}<5.0$	(00 00 FF)	blue
A	5.0	$5.0\leq\text{in}<6.0$	(32 00 96)	dark blue
B	6.0	$6.05\leq\text{in}<8.0$	(FF FF 00)	yellow
C	8.0	$8.0\leq\text{in}<10.0$	(FF AA 00)	orange
D	10.0	$10.0\leq\text{in}<12.0$	(FF 00 00)	bright red
E	12.0	$12.0\leq\text{in}<15.0$	(AE 00 00)	dark red
F	15.0	$15.0\leq\text{in}$	(FF FF FF)	white

29.2.3 Range/Data Resolution

The resolution of both the graphic and digital versions of this product is 1.1 nmi (range) by 1 deg (azimuth), out to a range of 124 nmi.

29.3 Annotations, Both versions of the product will contain the following:

29.3.1 Alphanumeric

Standard Annotations
Beginning/Ending Date and Time of Rainfall Rate Integration
Maximum Data Value
Radar Bias Estimate
Effective G-R Pair Sample Size
Gage Adjustment Bias Flag

29.3.1.1 (STP) Paired and (DSP) Digital Alphanumeric:

Adaptation Data, including:

(Enhanced Preprocessing Algorithm)

Width of the Radar Beam

Blockage Threshold

Clutter Threshold

Weight Threshold

Full Hybrid Scan Threshold

Low Refl. Threshold

Rain Detection Refl. Threshold

Rain Detection Area Threshold

Rain Detection Time Threshold

Z-R Multiplicative Coefficient

Z-R Power Coefficient

Minimum Reflectivity to Convert to Rate

Maximum Reflectivity to Convert to Rate

Number Exclusion Zones

(Rate Algorithm)

Maximum Storm Speed

Threshold Max Time Difference

Minimum Area Time Continuity

Time Continuity Parameter # 1

Time Continuity Parameter #2

Maximum Rate Echo Area Change

Range Cut-Off

Range Effect Coefficient #1

Range Effect Coefficient #2

Range Effect Coefficient #3

Minimum Precip. Rate

Maximum Precip. Rate

(Accumulation Algorithm)

Threshold Elapsed Time to Restart

Maximum Time for Interpolation

Minimum Time in Hourly Period

Threshold Hourly Outlier

Ending time Gage Accumulation

Maximum Period Accumulation Value

Maximum Hourly Accumulation Value

(Adjustment Algorithm)

Time bias Estimation

Threshold Number of Gage-Radar Pairs

Reset Bias Value

Longest Allowable Lag (Hours)

Bias Applied Flag

Selected Supplemental Data, including:

Average Scan Date
Average Scan Time
Flag Zero Hybrid
Flag Rain Detected
Flag Restart Storm Total
Flag Precip. Begin
Last Date Rain
Last Time Rain
Total No. of Blockage Bins Rejected
Total No. of Clutter Bins Rejected
Total Bins Smoothed
Percent of Hybrid Scan Filled
Highest Elevation Angle (degree)
Rain Area
Spot Blanking Status

Bias-Related Fields, including:

Date (modified Julian) of Last Update of Local Bias Value
Time (secs) of Last Update of Local Bias Value
Date (modified Julian) of Last Update of Local Bias Table
Time (secs) of Last Update of Local Bias Table
Observation Date (modified Julian) of Latest Bias Table
Observation Time (secs) of Latest Bias Table
Generation Date (modified Julian) of Latest Bias Table
Generation Time (secs) of Latest Bias Table
Mean- Field Bias Estimate
Effective G-R Pair Sample Size
Memory Span (Hours) used in Bias Estimate

Precipitation Status Message, Including:

Current Date Stamp
Current Time Stamp
Date Last Precip Detected
Time Last Precip Detected
Current Precip Category
Last Precip Category

29.3.2 Special Symbols

None

29.4 Product Interaction

The following overlay products are displayable on the graphic version of this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signatures.

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29.5 Comment

All site adaptable parameters identified as inputs to generate data for this product will be available at the alphanumeric display upon user request. This data will be formatted in a tabular layout showing the parameter name in one column and the value in an adjacent column.

30 HOURLY DIGITAL PRECIPITATION ARRAY (DPA)

30.1 SS Product Description

"The product shall provide hourly running total digital radar-rainfall estimates in an array format (not display oriented) to support processing performed external to the NEXRAD System. This product shall be available for 256 data levels for each array element. Each product shall include annotations for product name, radar ID, date and ending time (TSavcur* or clock hour as appropriate) of the rainfall rate integration, radar position, the radar operational mode, the maximum data value, the mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

30.2 Display Format

This is not a displayable product.

30.2.1 Data Levels

The accumulation data will be compacted-in the 1/40-LFM grid in a maximum of 256 levels, while the rate data will be compacted in the 1/4 LFM grid with a maximum of 8 levels. These levels are defined as follows:

8-Level

<u>Code</u>	<u>Display</u>	<u>Range (in/hr)</u>
0	0.0	0.0<in/hr<0.1
1	0.1	0.1<in/hr<0.3
2	0.3	0.3<in/hr<0.5
3	0.5	0.5<in/hr<1.0
4	1.0	1.0<in/hr<2.0
5	2.0	2.0<in/hr<4.0
6	4.0	4.0<in/hr
7	ND	

30.2.2 Color Level Code Tables

Not Applicable

30.2.3 Range/Data Resolution

The Adjusted Accumulation data ranges from -6 to 25.625 dBA and is reported in .125 dBA increments, where level codes 0 and 255 represent no accumulation and data outside the coverage area, respectively. Level codes 1 through 254 represent data values of -6 dBA to 25.625 dBA in 0.125 dBA increments. Rate data ranges from 0 to over 4 inches/hour in variable increments of rate. (Refer to para. 30.2.1.)

*See Algorithm Report

30.3 Annotations

30.3.1 Alphanumeric

Standard Annotations

Maximum Data Value

Supplemental Data, including:

End Date and End Time Hourly Accumulation

Total No. of Blockage Bins Rejected

Total No. of Clutter Bins Rejected

Number of Bins Smoothed

Percent of Hybrid Scan Bins Filled

Highest Elevation Angle used in Hybrid Scan

Total Hybrid Scan Rain Area

Number of Bad Scans in Current Hour

Radar Bias Estimate

Effective G-R Pair Sample Size

Current Volume Coverage Pattern Number

Current Operational (Weather) Mode

Missing Periods (Begin Date; Begin Time; End Date; End Time)

Adaptation Data, including:

(Enhanced Preprocessing Algorithm)

Width of the Radar Beam

Blockage Threshold

Clutter Threshold

Weight Threshold

Full Hybrid Scan Threshold

Low Refl. Threshold

Rain Detection Refl. Threshold

Rain Detection Area Threshold

Rain Detection Time Threshold

Z-R Multiplicative Coefficient

Z-R Power Coefficient

Minimum Reflectivity to convert to Rate

Maximum Reflectivity to convert to Rate

Number Exclusion Zones

(Rate Algorithm)

Maximum Storm Speed

Threshold Max Time Difference

Minimum Area Time Continuity

Time Continuity Parameter #1

Time Continuity Parameter #2

Maximum Rate Echo Area Change

Range Cut-Off

Range Effect Coefficient #1

Range Effect Coefficient #2

Range Effect Coefficient #3

Minimum Precip. Rate

Maximum Precip. Rate

(Accumulation Algorithm)

Threshold Elapsed Time to Restart
Maximum Time for Interpolation
Minimum Time in Hourly Period
Threshold Hourly Outlier
Ending Time Gage Accumulation
Maximum Period Accumulation Value
Maximum Hourly Accumulation Value
(Adjustment Algorithm)
Time Bias Estimation
Threshold Number of Gage-Radar Pairs
Reset Bias Value
Longest Allowable Lag (Hours)
Bias Applied Flag

30.3.2 Special Symbols

None

30.4 Product Interaction

None

31 SUPPLEMENTAL PRECIPITATION DATA (SPD)

31.1 SS Product Description

"This product shall provide selected supplemental data generated or collected during the operation of the precipitation processing subsystem algorithm. This product shall also provide the complete table of mean-field, gage-radar Bias values evaluated at different memory timespans (hours), received from AWIPS. This product shall be updated once per volume scan time. This product shall be produced in a tabular alphanumeric format. This product shall include annotations for product name, radar ID, radar position, date and time of volume scan, maximum data value, radar elevation above MSL, and radar operational mode."

31.2 Display Format

31.2.1 Graphic Display

This product does not have a graphic component.

31.2.2 Alphanumeric Display

This product is displayable only on the alphanumeric screen in tabular alphanumeric format (see Appendix C).

31.3 Annotations

31.3.1 Alphanumeric

Standard Annotations

(Part I):

Site Adaptation-RPG ID Number

Volume Scan Date and Time

Volume Coverage Pattern

Operational (Weather) Mode

Time Continuity Flag

Bias Applied Flag

Bias Estimate

Effective # Gage-Radar Pairs

Memory Span (Hours) used in Bias Estimate

Average Scan Date (Last Bias Update)

Average Scan Time (Last Bias Update)

Total No. of Blockage Bins Rejected

Total No. of Clutter Bins Rejected

Total No. of Final Bins Smoothed

Hybrid Scan Percent Bins Filled

Hybrid Scan Highest Elevation used

Hybrid Scan Total Rain Area

Begin Missing Period Date

Begin Missing Period Time

End Missing Period Date

End Missing Period Time

(Part II):

Average Scan Date (Last Bias Update)

Average Scan Time (Last Bias Update)
Bias Applied Flag (Yes/No)
Memory Span (Hours) (per evaluation timespan)
Effective # Gage-Radar Pairs (per evaluation timespan)
Average Gage Value (per evaluation timespan)
Average Radar Value (per evaluation timespan)
Mean-Field Bias Value (per evaluation timespan)

31.3.2 Special Symbols

None

31.4 Product Interaction

None

32 USER SELECTABLE RAINFALL ACCUMULATION (USP)

32.1 SS Product Description

"This product shall provide a rainfall accumulation map displayed as an image, for a user selected accumulation period. The product format and content shall be the same as the Surface Rainfall Accumulation (SS 28) and Storm Total Rainfall Accumulation (SS 29) products, except the accumulation period shall be of variable duration (in whole clock hours), ranging from a beginning to an ending time specified by the user. The product will usually be generated by request, but may also be generated routinely for limited, designated periods. One of these periods shall be the Default Period, which will span a 24 hour period from 1200z of the previous day to 1200z of the present day.

The default version of the product may be generated any time following the completion of the first volume scan to start after 1200z each day, up to 6 hours later. The period of accumulation shall be defined by the operator via two parameters: the Ending Hour (ranging from 0 to 23z), and the Time Span (ranging from 1 to 24 whole clock hours prior to the Ending Hour.) No more than 30 hours of rainfall data prior to the most recent clock-hour will be required to generate this product.

If a requested product cannot be generated due to an error condition, a message will be displayed explaining why, and the available hours of precipitation accumulation in the precipitation data base will be listed.

"This product shall include annotations for product name, radar ID, maximum data value detected, radar position, times and dates of the beginning and end (clock hour) of the rainfall rate integration, radar position, radar elevation above MSL, radar operational mode, the mean-field bias in the radar estimate of the precipitation rate (Bcur*), and the effective (Gage-Radar Pair) sample size associated with the bias estimate (GRPcur*)."

32.2 Display Format

The product is displayed in full-screen or quarter-screen format (see Appendix B).

32.2.1 Data Levels

The User Selectable Rainfall Accumulation is displayed in 16 data levels on one of two possible scales, based on the maximum data value detected: one scale corresponding to that presently in use for the Surface Rainfall Accumulation products (OHP & THP); the other scale corresponding to that presently in use for the Storm Total Rainfall Accumulation product (STP). The scale used for the User Selectable product will switch automatically between the two, with the OHP & THP scale in effect unless the product maximum data value exceeds the lower limit of the maximum data level (e.g. 8 inches), in which case the STP scale will be invoked. Each data level code may vary with operational mode and with NEXRAD (or agency) system adaptation data.

*See Algorithm Report

32.2.2 Color Level Code Tables

See sections 28.2.2 and 29.2.2.

32.2.3 Range/Data Resolution

The resolution of this graphic product is 1.1 nmi (range) by 1 deg (azimuth) out to a range of 124 nmi.

32.2.4 Alphanumeric Display

32.2.4.1 Graphic Screen

A tabular format (Appendix B, Format III, Configuration 6) will be displayable on the graphic display screens. The tabular format will include:

- (a) Gage Bias Flag
- (b) Number of Hours in product
- (c) End Times
- (d) Bias
- (e) Hours Included Flag

32.3 Annotations

32.3.1 Standard Annotations

Beginning/ending Date and Time of Rainfall Rate Integration
Maximum Data Value
Radar Bias Estimate
Effective G-R Pair Sample Size
Gage Adjustment Bias Flag

32.3.2 Special Symbols

None

32.4 Product Interaction

The following overlay products are displayable on this product:

- Hail Index
- Mesocyclone
- Severe Weather Probability
- Storm Tracking Information
- Tornado Vortex Signatures.

33 HYBRID SCAN REFLECTIVITY (HSR) AND DIGITAL HYBRID SCAN REFLECTIVITY (DHR)

33.1 SS Product Description

"This product shall provide radar-reflectivity values for the composite Hybrid Scan*, both displayed as an image and formatted as non-displayable digital data. This product shall be assembled from the lowest four elevation angles and yielding a representative reflectivity value at every sample bin location of a 1 degree by 1 kilometer polar grid, out to a range of 230 kilometers (124 nautical miles). This digital data is provided to support processing performed external to the NEXRAD System, and is not display oriented. This product shall be updated once every volume scan time.

The digital version of this product shall be available for 256 data levels at each sample bin location. Each digital product shall include annotations for the product name, radar ID, date and time of the scan (TSavcur*), radar position, radar elevation above MSL, radar operational mode, and the maximum data value (dBZ).

The image version of this product shall represent the Reflectivity data. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, maximum data value (dBZ), radar position, radar elevation above MSL, and radar operational mode."

33.2 Display Format

The image version of this product is displayed in full-screen format or quarter-screen format (see Appendix B). It will be formatted as an image radial product. The digital version is not a displayable product.

33.2.1 Data Levels

The 256 data levels of the digital product cover a range of reflectivity from -32.0 to 94.5 dBZ, in .5 dBZ increments. Level codes 0 and 1 correspond to "Below Threshold" and "Range Folded", respectively, while level codes 2 through 255 correspond to the reflectivity data itself.

The image version of this product shall contain 16 data levels. The range of data level values (dBZ) varies with operational mode, area climatology and season, and with NEXRAD system (or agency) adaptation data. The range of Reflectivity supported by the RDA is -32 to +95 dBZe.

33.2.2 Color Level Code Tables

For the digital version of this product, the color table is not applicable. The graphic version of this product color level codes shall be identical to that used by the 16 data level base Reflectivity defined in product specification 1.2.2.

33.2.3 Range/Data Resolution

The Hybrid Scan extends to a range of 124 nmi, on a 230 x 360 (.54 nmi x 1 degree-resolution) polar grid.

33.3 Annotations

33.3.1 Digital Alphanumeric

Standard Annotations

Time and Date of the Scan (Tsavcur*)

Spot Blanking Status

Maximum Data Value

Adaptation Data, including:
(Enhanced Preprocessing Algorithm)

Width of the Radar Beam

Blockage Threshold

Clutter Threshold

Weight Threshold

Full Hybrid Scan Threshold

Low Refl. Threshold

Rain Detection Refl. Threshold

Rain Detection Area Threshold

Rain Detection Time Threshold

Z-R Multiplicative Coefficient

Z-R Power Coefficient

Minimum Reflectivity to convert to Rate

Maximum Reflectivity to convert to Rate

Number Exclusion Zones

(Rate Algorithm)

Maximum Storm Speed

Threshold Max Time Difference

Minimum Area Time Continuity

Time Continuity Parameter #1

Time Continuity Parameter #2

Maximum Rate Echo Area Change

Range Cut-Off

Range Effect Coefficient #1

Range Effect Coefficient #2

Range Effect Coefficient #3

Minimum Precip. Rate

Maximum Precip. Rate

(Accumulation Algorithm)

Threshold Elapsed Time to Restart

Maximum Time for Interpolation

Minimum Time in Hourly Period

Threshold Hourly Outlier

Ending Time Gage Accumulation

Maximum Period Accumulation Value

Maximum Hourly Accumulation Value

(Adjustment Algorithm)

Time Bias Estimation

Threshold Number of Gage-Radar Pairs

Reset Bias Value

Longest Allowable Lag (Hours)

Bias Applied Flag
 Selected Supplemental Data, including:
 Average Scan Date
 Average Scan Time
 Flag Zero Hybrid
 Flag Rain Detected
 Flag Restart Storm Total
 Flag Precip. Begin
 Last Date Rain
 Last Time Rain
 Total No. of Blockage Bins Rejected
 Total No. of Clutter Bins Rejected
 Total Bins Smoothed
 Percent of Hybrid Scan Filled
 Highest Elevation Angle (degree)
 Rain Area
 Spot Blanking Status
 Bias-Related Fields, including:
 Date (modified Julian) of Last Update of Local Bias Value
 Time (secs) of Last Update of Local Bias Value
 Date (modified Julian) of Last Update of Local Bias Table
 Time (secs) of Last Update of Local Bias Table
 Observation Date (modified Julian) of Latest Bias Table
 Observation Time (secs) of Latest Bias Table
 Generation Date (modified Julian) of Latest Bias Table
 Generation Time (secs) of Latest Bias Table
 Mean-Field Bias Estimate
 Effective G-R Pair Sample Size
 Memory Span (Hours) used in Bias Estimate
 Precipitation Status Message, including:
 Current Date Stamp
 Current Time Stamp
 Date Last Precip Detected
 Time Last Precip Detected
 Current Precip Category
 Last Precip Category

33.3.2 Graphic Alphanumeric

Standard Annotations (Appendix A, I(A))

33.4 Product Interaction

Product interaction for the image version of this product is identical to the base Reflectivity defined in product specification 1.4.

*See NEXRAD Algorithm Report

34 CLUTTER FILTER CONTROL

34.1 SS Product Description

"This product shall provide for display of clutter filter Notchwidth and Bypass Maps as a radial image, for the user selected elevation segment and channel type. The product, while considered a volume product, is not generated every volume scan. The product shall be generated upon detection of updated clutter filter Notchwidth Map and/or bypass Map data received from the RDASC, or in response to user request(s) when product is not in the RPG Product Database. Two elevation segments are available for selection, they are Low and High. Two channel types are available for selection, they are Surveillance and Doppler."

This product shall include annotations for elevation segment number (1 or 2), channel (Surveillance or Doppler), bypass map generation date/time, Notchwidth Map generation date/time, all other standard annotations.

34.2 Display format

The product is displayed in full-screen or quarter screen format (see Appendix B).

34.2.1 Data Levels

The Clutter Filter Control Product is displayable in 8 data levels designating the filtering enabled over each area.

34.2.2 Color Level code Tables

8-Level Code	Op Select Code	Filter Level	Description
0	0	Filter Off	Disable Filter
1	1	No Clutter	Bypass Map in CTRL
2	1	Low (1)	Bypass Map in CTRL
3	1	Medium (2)	Bypass Map in CTRL
4	1	High (3)	Bypass Map in CTRL
5	2	Low (1)	Force Filter
6	2	Medium (2)	Force Filter
7	2	High (3)	Force Filter

34.2.3 Range/Data Resolution

The resolution of this graphic product is 1 km (range) by 1.4 deg (azimuth) out to a range of 124 nmi. (230 km)

34.3 Annotations

34.3.1 Alphanumeric

Standard Annotations
Elevation Segment Number
Channel (Surveillance or Doppler)
Bypass Map generation date/time
Notchwidth Map generation date/time

Document Number 2620003H
Code Identification 0WY55
WSR-88D ROC
29 July 2004
Open Build 6.0

34.3.2 Special Symbols

None defined

34.4 Product Interaction

None

35 ITWS DIGITAL BASE VELOCITY (ITWSDBV)

35.1 SS Product Description

"This product shall provide mean radial velocity in a digital array format to support processing external to the NEXRAD system. This product shall be generated for each azimuth scan (elevation) based upon user requirements. This product shall consist of a one degree by 1 kilometer polar grid out to a range of 115 kilometers (62 nautical miles). This product shall provide 256 data levels (including 254 mean radial velocity data levels and indications for data "below the Signal-to-Noise threshold" and "Range Folding") for each array element. The product shall be formatted as a Graphic Product as specified in the ICD for the RPG/Associated PUP, Document Number 2620001, using Digital Radial Data Array Packets, Figure 3-11c. In addition to the standard contents of the Graphic Product, this product shall include the minimum data value (in meters per second), the increment (in meters per second), the number of data levels, the elevation (in degrees), the maximum negative velocity detected (in knots) and the maximum positive velocity detected (in knots).

35.2 Display Format

This is not a displayable product.

35.2.1 Data Levels

The product will have 256 data levels with codes "0" and "1" corresponding to "Below Signal-to-Noise (S/N) Threshold" and "Range Folding", respectively. Data level codes 2 through 255 correspond to mean radial velocity -63.5 to +63 meters per second respectively in 0.5 meters per second increments. This data coding will be adhered to regardless of the Doppler Velocity Resolution of the data provided by the RDA. With a velocity precision code of 2 (see Product Specific Data), the range of velocities produced by RDA is -127 to +126 meters per second. Any velocity data exceeding the maximum (-63.5/+63) will be represented by the maximum velocity.

35.2.2 Color Level Code Tables

Color level code tables are not provided. The encoding velocities into the 256 level value is according to Table III-E, Base Data Scaling, in the RDA/RPG ICD, Document Number 2620002, with LSB=0.5.

35.2.3 Range/Data Resolution

This product will be a polar data array with a sample bin for each 0.54 NM slant range and each 1 degree (nominal) of angular rotation. The array will normally have up to 366 radials based upon the variation in width of the NEXRAD radials from 0.95 to 1.1 degrees. However, in certain conditions, radial width could vary from 0.1 to 2.0 degree with a maximum of 400 radials in a product. Angular rotation will be in degrees clockwise relative to True North. This product will extend to a range of 62 NM (115 km) with a data value for each .54 NM (1 km). This resolution is obtained by sampling every fourth data bin of the base velocity data. To reduce the product size to a useful detection volume, the range coverage at higher elevations will not include data over 18,000 feet AGL above the radar (as measured above a flat plane at the radar).

35.2.4 Product Specific Data

The following data, specific to this product, is included in the Graphic Product message according to standard procedures as follows. This information is also provided in the ICD for the RPG/Associated PUP, Figure 3-6 and Table V.

<u>Halfword</u>	<u>Field Name</u>	<u>Contents</u>	<u>Units</u>	<u>Range</u>	<u>Precision/ Accuracy</u>
30	Product Dependent (P3)	elevation angle	degrees	-1.0 to +45.0	0.1, Note 1
31	Data Level 1 Threshold	minimum data value	m/s*10	-63.5	Note 1
33	Data Level 2 Threshold	increment	m/s*10	0.5	Note 1
47	Data Level 3 Threshold	number of levels	N/A	0 - 255	1
48	Product Dependent (P4)	maximum negative velocity detected	knots	-123 to 0	1
49	Product Dependent (P5)	maximum positive velocity detected	knots	0 to +123	1
50	Product Dependent (P7)	velocity precision code	N/A	1 or 2	1, Note 2

Note 1.Scaled integer, precision determines scaling.

Note 2. Velocity precision code indicates the quantization of the base velocity data used to create this product. A value of 1 denotes 0.5 m/s and 2 denotes 1.0 m/s. Regardless of this code, product 93 is formatted as if the precision is always 0.5 m/s.

35.3 Annotations

35.4 Product Interaction

36 CLUTTER LIKELIHOOD REFLECTIVITY (CLR)

36.1 SS Product Description

The Clutter Likelihood Reflectivity product shall provide a displayable image of the percentage probability that the radar is detecting ground clutter in the reflectivity radial samples. The processing shall be based on the output of the Radar Echo Classifier (REC) algorithm using the Anomalous Propagation /Clutter target logic. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each product shall be available in an 11-level display. A separate data level code shall be used to represent sampled bins below SNR threshold. The product shall display the percentage likelihood of clutter for each reflectivity bin, from the radar to 124 nautical miles range. The product shall be a radial format display with a range resolution of 0.54 nautical miles. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, radar position, radar elevation above MSL and radar operational mode. Upon user request, all site adaptable parameters identified as inputs to the algorithm used to generate data for this product shall be available to the user.

36.2 Display Format

The product is displayable as a radial format, graphic image as described in the Interface Control Document for the RPG To Class 1 User.

36.2.1 Data Levels

The 11 color level codes used for display of REC AP/Clutter Likelihood Reflectivity are NEXRAD (or agency) system adaptation data. An example of color table for both Precipitation and Clear Air Modes is listed. With the exception of the end points, the lower value of the range is assigned to the individual colors displayed. The range of values for each is also indicated.

36.2.2 Color Level Code Tables

11-Level Clear Air and Precipitation Modes

11-Level Code	Display Percent	Range Percent	Color Levels	
			Code	Color
0	ND	SNR<TH or dBZ<5(<-28 for clear air mode)	(00 00 00)	black
1	0	0<%<10	TBD	TBD
2	10	10<%<20	(TBD)	(TBD)
3	20	20<%<30	(TBD)	(TBD)
4	30	30<%<40	(TBD)	(TBD)
5	40	40<%<50	(TBD)	(TBD)
6	50	50<%<60	(TBD)	(TBD)
7	60	60<%<70	(TBD)	TBD
8	70	70<%<80	(TBD)	TBD
9	80	80<%<90	(TBD)	TBD
A	90	90<%	(TBD)	TBD

36.2.3 Range/Data Resolution

The products are available for the following:

Coverage Area Resolution
(nmi Radius)(nmi x deg)Product Center

0 to 1240.54 x 1 Radar Location

36.3 Annotations

36.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))
Elevation Angle
Data Level Code
Site Adaptable Parameters

36.3.2 Special Symbols

None defined.

36.4 Product Interaction

All overlay products are displayable on this product:

Hail Index
Mesocyclone
Severe Weather Probability
Storm Tracking Information
Tornado Vortex Signature

37 CLUTTER LIKELIHOOD DOPPLER (CLD)

37.1 SS Product Description

The Clutter Likelihood Doppler product shall provide a displayable image of the percentage probability that the radar is detecting ground clutter in the Doppler radial samples. The processing shall be based on the output of the Radar Echo Classifier (REC) algorithm using the Anomalous Propagation /Clutter target logic. The product shall be generated for any azimuth scan at a single elevation angle based on user requirements. Each product shall be available in an 12-level display.

A separate data level code shall be used to represent sampled bins below SNR threshold. A separate data level code shall be used to represent bins where the Doppler data is undermined due to range folded data. The product shall display the percentage likelihood of AP/clutter for each Doppler bin, from the radar to 124 nautical miles range. The product shall be a radial format display with a range resolution of 0.54 nautical miles. The value displayed for a given 0.54 nautical mile bin shall be the maximum of the four corresponding Doppler bins. Each product shall include annotations for the product name, radar ID, time and date of scan, data level code, elevation angle, radar position, radar elevation above MSL and radar operational mode. Upon user request, all site adaptable parameters identified as inputs to the algorithm used to generate data for this product shall be available to the user.

37.2 Display Format

The product is displayable as a radial format, graphic image as described in the Interface Control Document for the RPG To Class 1 User.

37.2.1 Data Levels

The 12 color level codes used for display of REC Clutter Likelihood Doppler are NEXRAD (or agency) system adaptation data. An example of color table for both Precipitation and Clear Air Modes is listed. With the exception of the end points, the lower value of the range is assigned to the individual colors displayed. The range of values for each is also indicated.

37.2.2 Color Level Code Tables

12-Level Clear Air and Precipitation Modes

12-Level Code	Display Percent	Range Percent	Color Levels	
			Code	Color
0	ND	SNR<TH or dBZ<5 (<-28 for clear air mode)	(00 00 00)	black
1	0	0<%<10	(TBD)	(TBD)
2	10	10<%<19	(TBD)	(TBD)
3	20	20<%<29	(TBD)	TBD
4	30	30<%<39	(TBD)	TBD
5	40	40<%<49	(TBD)	TBD
6	50	50<%<59	(TBD)	TBD
7	60	60<%<69	(TBD)	TBD
8	70	70<%<79	(TBD)	TBD
9	80	80<%<89	(TBD)	TBD
A	90	90<%	(TBD)	TBD
B	RF	RF	(TBD)	TBD

37.2.3 Range/Data Resolution

The products are available for the following:

Coverage Area Resolution
(nmi Radius)(nmi x deg)Product Center

0 to 1240.54 x 1 Radar Location

37.3 Annotations

37.3.1 Alphanumeric

Standard Annotations (Appendix A, I(A))
Elevation Angle
Data Level Code
Site Adaptable Parameters

37.3.2 Special Symbols

None defined

37.4 Product Interaction

All overlay products are displayable on this product:

Hail Index
Mesocyclone
Severe Weather Probability
Storm Tracking Information
Tornado Vortex Signature

38 SUPEROB

38.1 SS Product Description

This product will contain 8 bit precision radial velocity data as an average of all base velocity bins within discrete sampling areas for a predetermined time span. The product, while considered a volume product, will not be generated every volume scan. The time span over which the velocity data is averaged will be adaptable between 10 minutes and 3 hours with the default value being 1 hour. The product will be generated at the end of the time span.

Each elevation scan will be divided into multiple sampling areas, or SuperOb cells. The SuperOb cells are defined by an adaptation data supplied range size and azimuth size. A maximum range will also be defined to limit the range extent of the averaging.

Velocity data will be averaged within these SuperOb cells for each elevation of the volume coverage pattern. If the volume coverage pattern changes during the time span, thereby causing a change in elevation angles, a tolerance will be established so that elevation differences beyond the tolerance will cause velocity data for the new elevation(s) to be averaged separately. Elevation differences within the tolerance value will cause velocity data from the new elevation(s) to be included in the averages for the nearest elevation.

A minimum number of samples for a usable average will be defined in adaptation data. If a SuperOb cell does not meet this minimum number of samples within the time span, an average will not be computed for that cell.

At the end of a time span, the resulting product will supply the following information for each SuperOb cell in each elevation: average radial velocity, root mean square of the average radial velocities, azimuth, latitude, longitude, height, and time deviation. The time deviation is the mean number of seconds deviation from the base time of all the sample times included in the SuperOb cell.

The base time is defined as the center of the time span of data collection base. The latitude, longitude, height and azimuth values are also determined from the mean of all samples in the SuperOb cell.

38.2 Display Format

38.2.1 Data Levels

The product will contain averaged velocity data in 8 bit (256 data level) precision.

38.2.2 Color Level Code Tables

Color level code tables are not provided. Information for the SuperOb cells in each elevation is formatted according to the RPG To Class I User Interface Control Document, Document Number 2620001, packet code 27.

38.2.3 Range/Data Resolution

The resolution and range extent of the SuperOb cells are determined from ORPG adaptation data. Adaptation data defines a range size (default 5 kilometers) and an azimuth size (default 6 degrees). Adaptation data also defines a maximum range for processing (default 100 kilometers).

38.2.4 Product Specific Data

The following data, specific to this product, is included in the Graphic Product message according to standard procedures as follows. This information is also provided in the ICD for the RPG To Class I User, Figure 3-6 and Table V.

Halfword	Field Name	Contents	Units	Range	Precision/Accuracy
27	Product Dependent (P1)	Base Time	minutes	0 to 1439	1
28	Product Dependent (P2)	Time Radius	minutes	5 to 90	1
47	Product Dependent (P4)	SuperOb Cell Range Size	km	1 to 10	1
48	Product Dependent (P5)	SuperOb Cell Azimuth Size	degrees	2 to 12	1
49	Product Dependent (P6)	Maximum Range	km	60 to 230	1
50	Product Dependent (P7)	Minimum Number of Samples	N/A	20 to 200	1

38.3 Annotations

38.4 Product Interaction

39 DIGITAL HIGH RESOLUTION VERTICALLY INTEGRATED LIQUID (HRVIL)

39.1 SS Product Description

“This product shall provide digital values of vertically integrated liquid (VIL) in a polar radial format. These digital, high-resolution VIL data are provided to support processing performed external to the NEXRAD System. A polar VIL algorithm similar to the original NEXRAD VIL Algorithm shall be used. Input to HRVIL is provided on an elevation basis by the Data Quality Assurance (DQA) algorithm. The DQA analyzes the reflectivity factor data to detect and remove both constant power signature artifacts and anomalous propagation. The HRVIL product shall produce a representative VIL value at every sample bin location of a 1 kilometer (0.54 nautical mile) by 1 degree polar grid, out to a range of 460 kilometers (248 nautical miles). The product shall be updated once per completion of a full volume scan. This product shall provide for 256 data levels including three values reserved for flagging. The product shall be formatted as a Graphic Product as specified in the ICD for Class 1 Users (Document Number 2620001) using Digital Radial Data Array Packets as described in Figure 3-11c.

Each digital product shall include annotations for product name, radar ID, time and date of volume scan, maximum data value (digital VIL value), radar position, radar elevation above MSL, and the radar operational mode.”

39.2 Display Format

This is not a displayable product.

39.2.1 Data Levels

The product will have 256 data levels with codes "0" and "1" corresponding to "Below threshold data" and "flagged data", respectively. Digital value 255 also is reserved for future use as a flag, if needed. Data level codes 2 through 254 correspond to VIL values ranging from 0.05 kg m to a maximum of 80 kg m. Any VIL value above 80 kg m is assigned a digital data value of 254. The following table lists the equations used to convert VIL to a digital value:

Digital VIL (DVL) Range	VIL Range (kg m)	Equation
0	<0.05	-
2-19	$0.05 \leq \text{VIL} < 0.189$	$\text{DVL} = 123.2702 * \text{VIL} - 4.1635$
20-254	≥ 0.189	$\text{DVL} = 38.8763 * \text{LN}(\text{VIL}) + 83.9028$

39.2.2 Color Level Code Tables

For this digital product, the color table is not applicable.

39.2.3 Range/Data Resolution

The resolution of this polar product is 0.54 nmi (1 km) in range by 1 degree in azimuth out to a radial range of 248 nmi (460 km). The radar location is at the product center.

39.3 Annotations

39.3.1 Alphanumeric

The automated annotations for this product are:
Standard Annotations (Appendix A, I(A))
Digital Data Level to VIL Conversion Information
Maximum Digital Data Value Detected
Number of artifact edited radials volume

39.3.2 Special Symbols

None defined.

39.4 Product Interaction

None.

40 USER SELECTABLE LAYER COMPOSITE REFLECTIVITY (ULR)

40.1 SSS Product Description

"This product shall be provided on a 1 degrees by 1 kilometer polar grid, out to a range of 230 kilometers (124 nautical miles). For each resolution element, this product shall provide the maximum reflectivity value above the resolution element of sample bins intersecting the layer from any elevation angle scan of a volume scan. At most ten layers shall be available per volume. The altitude limits of each layer shall be specified by user product request. No layer shall be less than 1,000 ft thick. Each layer product shall be updated on a volume scan basis. Sixteen data levels shall be available for each product, including one for data below minimum Signal-to-Noise threshold and one for unavailable data. Data is unavailable at a given range resolution element to gaps between elevation scans or if the given resolution element lies above the layer or below the layer. Each product shall contain annotations for product name, radar ID, date and time of volume scan, maximum data value detected, radar position, radar elevation above MSL, and radar operational mode."

40.2 Display Format

40.2.1 Data Level

This product shall contain 16 displayable levels (4 bits) as follows: the first data level shall depict data below the signal - to- noise ratio threshold; the second data level shall depict data which is unavailable due to gaps in the Volume coverage Pattern; the third data level shall contain all data greater than signal-to-noise threshold and less than -5 dBZ; the last data level shall contain all data greater or equal to 55 dBZ; the remaining twelve data levels shall depict reflectivity values greater or equal to -5 dBZ to less than 55 dBZ, at increments to 5 dBZ.

40.2.2 Color Level Code Tables

16-Level Code	Display dBZ	Range dBZ	Code	Color
0	>TH	SNR<TH or dBZ <-32	TBD	TBD
1	ND	ND	TBD	TBD
2	>-5	-32<=dBZ<-5	TBD	TBD
3	-5	-5<=dBZ<0	TBD	TBD
4	0	0<=dBZ<5	TBD	TBD
5	5	5<=dBZ<10	TBD	TBD
6	10	10<=dBZ<15	TBD	TBD
7	15	15<=dBZ<20	TBD	TBD
8	20	20<=dBZ<25	TBD	TBD
9	25	25<=dBZ<30	TBD	TBD
10	30	30<=dBZ<35	TBD	TBD
11	35	35<=dBZ<40	TBD	TBD
12	40	40<=dBZ<45	TBD	TBD
13	45	45<=dBZ<50	TBD	TBD
14	50	50<=dBZ<55	TBD	TBD
15	55	55<=dBZ	TBD	TBD

40.2.3 Range/Data Resolution

The product coverage area is 360 degrees x 124 nm. The resolution is 1 degree x 0.54 nm. The product is centered at the radar location.

40.3 Annotations

40.3.1 Alphanumeric

Standard Annotation (Appendix A).

Data Level Codes

Maximum Data Value Detected

Requested Altitudes of the Layer Bottom and (to correct request errors as described below)

To permit product generation, invalid product request parameters (i.e., ICD non-compliance such as layer altitude outside of 0 or 70k ft, or minimum thickness less than 1k ft) shall be modified according to the following rules: (A) If the layer bottom altitude is less than 0k ft, generate a product based on a layer bottom altitude of 0k ft; (B) If the layer top altitude is greater than 70k ft, generate a product based on a layer top altitude of 70k ft; (C) If the layer thickness is zero, generate a product based on the top altitude being 1k ft higher than the layer bottom altitude; (D) If the layer top (bottom) altitude are both above (below) the valid altitude limits, generate a product with the layer top (bottom) altitude set to 70k ft (0k ft) and with the other altitude set to 1k ft lower (higher); (E) If the layer top altitude is less than the layer bottom altitude, switch the limits so that the layer depth is greater than zero.

40.3.2 Special Symbols

None defined.

41 DIGITAL HIGH RESOLUTION ENHANCED ECHO TOPS (HREET)

41.1 SS Product Description

"This product shall provide the echo tops information to support processing performed by external systems. Reflectivity data used to generate this product shall be edited for artifacts and anomalous propagation by the Data Quality Assurance algorithm. The HREET product shall be updated once per volume scan time. This product shall report echo tops at a vertical resolution of 1000 feet referenced to mean sea level on a 1 degree by 1 kilometer polar grid to a range of 345 kilometers (186 nautical miles). Echo top data shall be flagged to indicate the "topped" condition, meaning echo tops may be higher than indicated. A Topped condition results when either the reflectivity is greater than the threshold of 18 dBZ at the top elevation scan, or when the value immediately above a 18+ dBZ value is bad and no other values at higher elevations are above threshold. Additionally, two values shall be reserved for "no data" and "bad data". A sample bin is flagged "bad data" if the reflectivity was edited by the DQA algorithm. The value "no data" means there are no reflectivity data above threshold at the location of the sample bin. The flagged conditions can not be "topped".

"Each product shall include annotations for product name, radar ID, time and date of volume scan, maximum data value (echo top), echo top reflectivity threshold value, the number of radials in volume determined to be artifacts, radar position, radar elevation above MSL, and the radar operational mode."

41.2 Display Format

41.2.1 Data Levels

The product will have 71 data levels with codes "0" and "1" corresponding to "missing data" and "bad data", respectively. Data level codes 2 through 71 correspond to EET values ranging from 0.0 kft to a maximum of 69.9 kft. Any EET value at or above 70 kft is assigned a value of 1 (bad data). The following table lists the data levels used and their corresponding EET values.

Digital EET Range	EET Range (kft)
0	Missing data
1	Bad data
2-71	$0 \leq \text{EET} < 70$
130-199	$0 \leq \text{"topped" EET} < 70$

41.2.2 Color Level Code Tables

For this digital product, the color table is not applicable.

41.2.3 Range/Data Resolution

The resolution of this polar product is 0.54 nmi (1 km) in range by 1 degree in azimuth out to a radial range of 186 nmi (345 km). The radar location is at the product center.

41.3 Annotations

41.3.1 Alphanumeric

The automated annotations for this product are:
Standard Annotations (Appendix A, I(A))
Digital Data Level to EET Conversion Information
Maximum Digital Data Value Detected
Number of artifact edited radials in volume
Echo Top threshold value (in dBZ)

41.3.2 Special Symbols

None defined.

41.4 Product Interaction

None.

42 ONE HOUR SNOW ACCUMULATION (OSW, OSD)

42.1 SS Product Description

"These products shall provide radar algorithm estimated 1-hour snow water equivalent and snow depth accumulation images. The products shall be updated every volume scan. The products shall be available for 16 data levels. Each product shall include annotations for the product name, radar ID, date and ending time of the accumulation, the type of range/height correction (such as algorithm derived or static) has been applied to the accumulation, maximum data value, azimuth and range of the maximum value, radar position, radar elevation above MSL, and radar operational mode."

42.2 Display Format

42.2.1 Graphical Display

The products are displayable in full-screen format or quarter-screen format (see Appendix B) as a radial product. The product will contain 16 data levels. The table below defines the default color and data levels. Color and data levels may vary with display systems and with NEXRAD (or agency) preferences.

42.2.1.1 Color Level Code Table

		OSW		OSD		Color Levels	
16-Level Code	Display 100ths Inches	Range Inches	Display Inches	Range Inches	Code	Color	
0	ND	in=0.0	ND	in=0.0	(00 00 00)	black	
1	>0	0.0<in<0.01	>0.00	0.0<in<0.05	(AA AA AA)	gray	
2	1	0.01≤in<0.02	0.05	0.05≤in<0.10	(76 76 76)	dark gray	
3	2	0.02≤in<0.03	0.10	0.10≤in<0.15	(00 FF FF)	cyan	
4	3	0.03≤in<0.05	0.15	0.15≤in<0.25	(00 AF AF)	dark cyan	
5	5	0.05≤in<0.07	0.25	0.25≤in<0.50	(00 FF 00)	green	
6	7	0.07≤in<0.09	0.50	0.50≤in<0.75	(00 8F 00)	dark green	
7	9	0.09≤in<0.11	0.75	0.75≤in<1.00	(FF 00 FF)	magenta	
8	11	0.11≤in<0.13	1.00	1.00≤in<1.50	(AF 32 7D)	dark magenta	
9	13	0.13≤in<0.16	1.50	1.50≤in<2.00	(00 00 FF)	blue	
A	16	0.16≤in<0.20	2.00	2.00≤in<2.50	(32 00 96)	dark blue	
B	20	0.20≤in<0.25	2.50	2.50≤in<3.00	(FF FF 00)	yellow	
C	25	0.25≤in<0.30	3.00	3.00≤in<3.50	(FF AA 00)	orange	
D	30	0.30≤in<0.35	3.50	3.50≤in<4.00	(FF 00 00)	bright red	
E	35	0.35≤in<0.40	4.00	4.00≤in<5.00	(AE 00 00)	dark red	
F	40	0.40>in	5.00	5.00>in	(FF FF FF)	white	

42.2.1.2 Range/Data Resolution

The resolution of the graphic products is 0.54 nmi (range) by 1 deg (azimuth) and has a maximum range of 124 nmi.

42.2.2 Alphanumeric Display

Upon request, all site adaptable and configuration parameters for this product will be available as an alphanumeric display. This data will be formatted in a tabular layout showing in sequential columns the parameter names, values, and units.

42.3 Annotations

42.3.1 Alphanumeric

Standard annotations

Starting date [of snow accumulation]

Starting time [of snow accumulation]

Ending date [of snow accumulation]

Ending time [of snow accumulation]

Maximum Value

Azimuth of Maximum Value

Range to Maximum Value

Range/height Correction Applied: RCA or static

Missing Time - cumulative length in time of the missing periods

42.3.2 Special Symbols

None

42.4 Product Interaction

None

43 STORM TOTAL SNOW ACCUMULATION (SSW AND SSD)

43.1 SS Product Description

"These products shall provide radar algorithm estimated storm total snow water equivalent and snow depth accumulation images. The products shall be updated every volume scan. The products shall be available for 16 data levels. Each product shall include annotations for the product name, radar ID, starting and ending date and time of the accumulation, the type of range/height correction (such as algorithm derived or static) has been applied to the accumulation, maximum data value, azimuth and range of the maximum value, radar position, radar elevation above MSL, and radar operational mode."

43.2 Display Format

43.2.1 Graphical Display

The products are displayable in full-screen format or quarter-screen format (see Appendix B) as a radial product. The product will contain 16 data levels. The table below defines the default color and data levels. Color and data levels may vary with display systems and with NEXRAD (or agency) preferences

43.2.1.1 Color Level Code Table:

16-Level Code	SSW		SSD		Color Levels	
	Display Inches	Range Inches	Display Inches	Range Inches	Code	Color
0	ND	in=0.0	ND	in=0.0	(00 00 00)	black
1	>0.00	0.0<in<0.05	>0.00	0.0<in<0.5	(AA AA AA)	gray
2	0.05	0.05≤in<0.10	0.5	0.5≤in<1.0	(76 76 76)	dark gray
3	0.10	0.10≤in<0.15	1.0	1.0≤in<2.0	(00 FF FF)	cyan
4	0.15	0.15≤in<0.20	2.0	2.0≤in<3.0	(00 AF AF)	dark cyan
5	0.20	0.20≤in<0.25	3.0	3.0≤in<4.0	(00 FF 00)	green
6	0.25	0.25≤in<0.30	4.0	4.0≤in<5.0	(00 8F 00)	dark green
7	0.30	0.30≤in<0.40	5.0	5.0≤in<6.0	(FF 00 FF)	magenta
8	0.40	0.40≤in<0.50	6.0	6.0≤in<8.0	(AF 32 7D)	dark magenta
9	0.50	0.50≤in<0.75	8.0	8.0≤in<10.0	(00 00 FF)	blue
A	0.75	0.75≤in<1.00	10.0	10.0≤in<12.0	(32 00 96)	dark blue
B	1.00	1.00≤in<1.25	12.0	12.0≤in<15.0	(FF FF 00)	yellow
C	1.25	1.25≤in<1.50	15.0	15.0≤in<20.0	(FF AA 00)	orange
D	1.50	1.50≤in<2.00	20.0	20.0≤in<25.0	(FF 00 00)	bright red
E	2.00	2.00≤in<2.50	25.0	25.0≤in<30.0	(AE 00 00)	dark red
F	2.50	2.50>in	30	30.0>in	(FF FF FF)	white

43.2.1.2 Range/Data Resolution

The resolution of the graphic products is 0.54 nmi (range) by 1 deg (azimuth) and has a maximum range of 124 nmi.

43.2.2 Alphanumeric Display

Upon request, all site adaptable and configuration parameters for this product will be available as an alphanumeric display. This data will be formatted in a tabular layout showing in sequential columns the parameter names, values, and units.

43.3 Annotations

43.3.1 Alphanumeric

Standard annotations

Starting date [of snow accumulation]

Starting time [of snow accumulation]

Ending date [of snow accumulation]

Ending time [of snow accumulation]

Maximum Value

Azimuth of Maximum Value

Range to Maximum Value

Range/height Correction Applied: RCA or static

Missing Time - cumulative length in time of the missing periods

43.3.2 Special Symbols

None

43.4 Product Interaction

None

44 USER SELECTABLE SNOW ACCUMULATION (USW, USD)

44.1 SS Product Description

"These products shall provide radar algorithm estimated storm total snow water equivalent and snow depth accumulation images for a user selected accumulation period. The product format and content shall be the same as the storm total snow accumulation products, except the accumulation period shall be of variable duration and in whole top-of-the-hour clock hours. The products shall be updated at the top of the every hour (as requested). The accumulation period shall be definable by the requester via two parameters: the Ending Hour (ranging from 0 to 23Z) and the Time Span (ranging from 1 to 30 whole clock hours prior to the Ending Hour.) The product will usually be generated by request, but may also be generated routinely for designated periods. The default accumulation period shall span a 24 hour period from 1200Z of the previous day to 1200Z of the present day.

The products shall be available for 16 data levels. Each product shall include annotations for the product name, radar ID, dates and times of the starting and end (clock hour) of the snow accumulation, the type of range correction (such as algorithm or static derived) has been applied to the accumulation, maximum data value, azimuth and range of the maximum value, radar position, radar elevation above MSL, and radar operational mode."

44.2 Display Format

44.2.1 Graphical Display

The product is displayed in full-screen or quarter-screen format (see Appendix B).

44.2.1.1 Color Level Code Tables

The User Selectable Snow Accumulation is displayed in 16 data levels on one of two sets of scales based on the maximum data value detected: a) one scale corresponding to that presently in use for the One Hour Snow Accumulation products (OSW for snow water equivalent or OSD for snow depth), or b) a scale corresponding to that used for the Storm Total Snow Accumulation products (SSW for snow water equivalent or SSD for snow depth). The scale used for the user selectable snow accumulation product (USW or USD) will switch automatically between the two, with the OSW or OSD scales in effect unless the product maximum data value exceeds the lower limit of the maximum data level in which case the SSW or SSD scale will be invoked. Color and data levels will vary with display systems and with NEXRAD (or agency) preferences. Data levels will vary as changes are made to the OSW, OSD, SSW, and SSD color and data levels.

44.2.1.2 Range/Data Resolution

The resolution of this graphic product is 0.54 nmi (range) by 1 deg (azimuth) out to a range of 124 nmi.

44.2.2 Alphanumeric Display

Upon request, all site adaptable parameters for this product will be available as an alphanumeric display. This data will be formatted in a tabular layout showing in sequential columns the parameter names, values, and units.

44.3 Annotations

44.3.1 Alphanumeric

Standard annotations

Starting date [of snow accumulation]

Starting time [of snow accumulation]

Ending date [of snow accumulation]

Ending time [of snow accumulation]

Maximum Value

Azimuth of Maximum Value

Range to Maximum Value

Range/height Correction Applied: RCA or static

End Hour

Time Span

Available hours

44.3.2 Special Symbols

None

44.4 Product Interaction

None

APPENDIX A

Annotations, Symbols, Abbreviations, and Display Features

I. Annotations

(A) Standard Annotations

Every color Graphic product and most alphanumeric products will have, as a minimum, the following automated annotations (except as otherwise noted in specific product descriptions):

- Product Specification
- Standard Units, Annotations, Symbols, Abbreviations, and Display Features
- Product name
- Date/time of elevation, volume or azimuth scan
- RDA ID
- RDA Position (A/N Location)
- RDA elevation above MSL (feet)
- Operational mode.

(B) Special Symbols and Characters

The following special symbols and characters will be used in each product display as appropriate. Any further refinement for particular product will be made in the product specification.

(1) Storm ID

Each identified storm will be given a unique ID of two characters. The first character will be a capital letter, A through Z, and the second will be a number, 0 through 9. The sequence will be A0, B0, C0,...Z0, A1, B1, C1,...Z1, A2,...Z9. The sequence is recycled following Z9. When there has not been any storm cells identified in a user specified "number of past volume scans", then the sequence of IDs will be reset so that the next storm cell identified will have the ID A0. The ID will be white (code FF FF FF) and the background in black (code 00 00 00).

(2) Storm Cell Track

The storm cell track consists of past, current, and forecast storm cell centroid positions connected by one pixel wide linear segments. Past positions will be displayed as white filled (5-pixel diameter) circles.

Current positions will be displayed as a circle (7-pixel diameter) with an "X" inside the circle.

Forecast positions will be displayed as a circle (7-pixel diameter) of white plus signs, 1 pixel wide, of similar size. Forecast interval is a user agency or NEXRAD system option. This product specification uses a 15-minute default value.

For stationary cells, no past or forecast storm cell positions will be displayed. Instead, stationary storm cells shall be denoted by a circle (12-pixel diameter) concentric with the current position symbol.

(3) RDA Position

The associated RDA symbol will be displayed as a white open 1 pixel circle which is 5 pixels in diameter and is centered on the RDA location.

(4) Mesocyclone

The mesocyclone will be displayed (centered on the location of the mesocyclone at the lowest elevation angle in which it is detected) as a yellow open circle, whose perimeter is 4 pixels thick. The size of the symbol will be proportional to the average of the mesocyclone radial and azimuthal diameters. The minimum size symbol will be a circle having a diameter of 14 pixels. See section 20.3.2 for MRU, MD and DMD special symbol product requirements.

(5) Correlated 3D Shear

The 3D correlated shear will be displayed as a yellow open circle 1 pixel thick and is centered (similarly to the mesocyclone) on the 3D shear center at the lowest elevation angle at which it was detected. The size will be proportional to the average diameter. The minimum size symbol will be a circle having a diameter of 14 pixels. See section 20.3.2 for MRU, MD and DMD special symbol product requirements.

(6) Hail

The hail symbol is a green isosceles triangle. The triangle can be small (a base of 8 pixels and height of 12 pixels) or large (a base of 16 pixels and a height of 20 pixels). The size of the triangle and whether the triangle is filled depends upon the Probability of Severe Hail and the Probability of Hail. The following are the rules of display and default settings.

Triangle	Probability of Severe <u>Hail</u>	Probability of Hail
Large/Filled	$\geq 50\%$	N/A
Large/Open	$\geq 30\%$	N/A
Small/Filled	0%	$\geq 50\%$
Small/Open	0%	$\geq 30\%$

However, the probabilities are adaptable parameters at the PUP alphanumeric terminal, and the user has the ability to disable the display of one or both of the small and/or large triangles. The Maximum Expected Hail Size will be displayed in the middle of the triangle.

(7) TVS

The TVS symbol is an inverted red-filled isosceles triangle, and the symbol for an Elevated TVS (ETVS) is the same except it is unfilled. The triangle has a base of 7 pixels and a height of 12 pixels. See section 21.4 for TRU special symbol product requirements.

II. Standard and Product Specific Annotation Display

The annotations are automated, entered and displayed on the 128 by 512 pixel screen right area in white except where specified. All alphanumeric characters will fit into a 7 by 9 pixel area and the number of characters in a single horizontal line will not exceed 18 characters assuming standard spacing between them.

In addition:

(1) The radar position which will be displayed at its actual location as described (I.B.3) on the graphic display. In addition, the RDA latitude and longitude will be displayed in the screen right area.

(2) The Data Level Code colors will be displayed as specified in the Color Level Code Tables.

(3) Storm ID, Storm Track, TVS, mesocyclone and hail overlays are all to be overlaid on a number of other products. They may be overlaid individually or in combination on a displayed product. To ensure readability when displayed in combination, a placement algorithm is required that will allow

the symbols to be placed in close proximity with the storm to which the phenomena apply without interference between symbols and without interference with the image.

The following rules apply to the algorithm:

- Storm ID - will be placed 5 pixels east and 5 pixels to the south of the storm centroid for all products and overlays.
- Storm Track - will be displayed as indicated on the Storm Track Information product.
- TVS - The apex of the symbol will be placed on any product at the position corresponding to the TVS (or ETVS) position at the lowest elevation angle where it is detected.
- Mesocyclone - will be overlaid on any product at a position corresponding to its position at the lowest elevation angle where it is detected.
- Hail symbol - will be placed to the right of the storm ID.

Pixel color precedence, in the event that some symbols overlay each other, or the imagery is specified in PUP adaptation Data. The current precedence follows:

- TVS
- Mesocyclone
- Storm track information and storm ID
- Hail

Background Map (background or foreground) and imagery have the lowest precedence and which one is the absolute lowest depends on whether the background maps are in the foreground or background.

(4) Display of Storm Attribute Data

Storm attribute data is obtained as direct output of the following algorithms: mesocyclone, hail, TVS detection, storm cell segments, storm cell centroids, storm cell tracking, and storm position forecast. These will be displayed on the upper portion (52 by 512 pixel area) of the graphic display area. This storm attribute section has been designed into the graphic display Format III (Appendix B). In each of the configurations only a limited number of storm cells can be accommodated, and, therefore, to obtain attribute information on remaining storm cells, paging is necessary. The data content and format have been configured for five different attribute data sets which are listed below.

Configuration 1 is applied to the Storm Tracking Information (STI) and includes data on storm ID, storm cell centroid position (AZRAN), forecast speed and direction of the storm cell ("NEW" is indicated during first volume scan storm cell is detected); forecast error and mean forecast error; maximum reflectivity in dBZ and its height. The table outline for the STI attribute data shall be cyan. When STI is displayed as a stand alone product, the annotations will be displayed. When it is overlaid on other products which include an attribute table, the STI table replaces the overlaid product's table. By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the UCP operator has the capability to limit the number of storm cells included in this format from 6 to 100.

Configuration 2A, associated with the Mesocyclone product data set, includes storm ID, feature position (AZRAN), feature type, base and top of the feature and radial and azimuthal diameter. The table outline for the Mesocyclone attribute data shall be yellow. The mesocyclone product is a stand alone product as well as an overlay product and the manner in which Configuration 2 is handled is the same as that of Configuration 1.

Configuration 2B, associated with the Mesocyclone Rapid Update (MRU) product closely follows the Mesocyclone product. Differences are described in section 20.2.2. The table outline for the MRU

attribute data shall be yellow. The MRU product is a stand alone product as well as an overlay product and the manner in which Configuration 2B is handled is the same as that of Configuration 1. Configuration 2C, associated with the Mesocyclone Detection (MD) product closely follows the Mesocyclone product. Differences are described in section 20.2.2. The table outline for the MDA attribute data shall be yellow. Due to a limit of 6 pages, only the strongest 36 MDA features are included in the Attribute Data. The MDA product is a stand alone product as well as an overlay product and the manner in which Configuration 2C is handled is the same as that of Configuration 1.

Configuration 3 is applied to the TVS product, which is a stand alone product and overlay or annotation to other products. For each TVS and Elevated TVS (ETVS) the following attributes are listed: type (TVS or ETVS), storm cell ID, (base) position (AZ/RAN), average delta velocity, low-level (base) delta velocity, maximum delta velocity, base height, and depth. (NOTE: If the base is detected on the lowest elevation scan of the volume scan, then the base (height) is qualified with '<' respectively. And, if either the base or top are detected on the lowest or highest elevation scan of the volume scan, then the depth is also qualified with a '>'.) The table outline for the TVS attribute data shall be red. Configuration 3B, associated with the TVS Rapid Update (TRU) product closely follows the TVS product. Differences are described in section 21.2 and 21.2.1.1. The manner in which the configuration data and the image data are handled when overlaid on other products (including other overlay products) is the same as that of Configurations 1 and 2.

Configuration 4 is applied to the Hail Index product, which is a stand alone product or an overlay to other products. The attribute data set of Configuration 4 includes the storm cell ID, storm cell centroid position (AZ/RAN), the probability of severe hail, the probability of hail, the maximum expected hail size, the user selectable hail temperature altitudes (MSL) (of the 0° C and -20° C environmental temperatures), and the time and date of the last change to the hail temperature altitudes. The table outline for the Hail attribute data shall be green. The manner in which Configuration 4 is displayed is the same as that described for Configuration 1. By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the UCP operator has the capability to limit the number of storm cells included in this format from 6 to 100.

Configuration 5 is displayable only with the composite reflectivity products. The information displayed includes storm ID; storm cell centroid position (AZ/RAN) (to the nearest degree/nmi); TVS (TVS, ETVS, or NONE); mesocyclone (MESO, 3DCO, UNCO, or NONE); probability of severe hail (%), probability of hail (%), and maximum expected hail size (to the nearest quarter inch); cell-based VIL (to the nearest kg/m**2); maximum reflectivity (to the nearest dBZ) and its height (AGL) size (to the nearest tenths kft); storm tops (to the nearest tenths kft); and forecast speed and direction (to the nearest degree/nmi) of the storm cell ("NEW" is indicated during first volume scan storm cell is detected). If both a TVS and ETVS are associated with the same storm cell, then "TVS" will be displayed. The storm cells will be ranked in the following order: TVSs, ETVSs, MESOs, 3-D Correlated Shears, 2-D Uncorrelated Shears, POSH, POH, and Cell-based VIL. TVSs or ETVSs which are not associated with a storm cell will not be included in this table. The table outline for the combined attribute data shall be orange. (NOTE: The Storm Top (TOP) data is qualified with '>' if the storm top was detected on the highest elevation scan of the Volume Coverage Pattern.) By default, all storm cells (entries), up to a maximum of 100, can be displayed in this format. However, the UCP operator has the capability to limit the number of storm cells included in this format from 4 to 100.

The maximum number of storm cells whose attributes are included is adaptable at the UCP.
Notes:

(1)All overlay products may be overlaid on each other or other geographic products.

(2)All complete attribute data sets for each of the overlay products are also available as a tabular output on the A/N screen.

(3)Any overlay may be defined in PUP adaptation data as a default overlay on any geographic product.

(4)Magnification of an individual storm or limited area requires special handling of the attribute data display. Any of the Attribute Tables may be accessed. However, to obtain specific attribute data for the magnified storm (or area), paging of the data may be required until the specific storm attribute data appears.

III. Summary Tables

(1) Units

Table I, Parameter Standard Dimensions, specifies where applicable, the units and resolutions of the parameters that will be used in the product display design.

(2)Product Parameters

Table II, Product Parameters, lists those parameters which define each of the SS products and their variations.

(3)Standard Abbreviations

The standard abbreviations to be used on the graphic display are contained in Table III.

IV.Product Display Formats

The 640 by 512 pixel display screen has been partitioned into two major areas. The status and annotation area is defined as the 128 by 512 pixel area on the extreme right of the display screen. The remaining 512 by 512 pixel area is identified as the "graphic display area."

Two basic graphic area formats (Appendix B) have been identified; they are:

(1)Format I - Full screen display (512 by 512 pixels) with a 52 by 512 pixel area available in the upper portion of the screen for displaying storm attribute data and the remaining 460 by 512 pixel area reserved only for image display.

(2)Format II - Quarter screen display with the 512 by 512 pixel area partitioned into four quarter screens, 256 by 256 pixels each. Each quarter screen reserves the lower 56 by 256 pixel area for color level code and product name display; the remainder is used for imagery.

TABLE I. PARAMETER STANDARD DIMENSIONS FOR DISPLAY

PARAMETER	CHARACTERS	UNITS
Altitude	HHHHH	feet
Base/Tops	XX.X	10 ³ feet
Clutter Likelihood	XX	percent
Date (Calendar)	MM:DD:YY	month, day, year
Date Level Code	XX.X	(integer)
Display Center Coordinate:		
Azimuth/Range (AZRAN)	DDD/XXX	degrees/nmi (integer)
Latitude/Longitude	DDMMSS/DDDMSS	degrees, minutes/seconds
Diameter	XX.X	nmi
Direction of storm motion	DDD	degrees (integer)
Elevation Angle	DD.D	degrees and tenths
Error, Variance	XX.X	kts
Mean Radial Velocity	XX	kts (integer)
Orientation/Rotation	XX.X/.XXX	degrees/radians
Radar elevation above MSL	HHHH	feet
Range	XXX	nmi (integer)
RDA	XXXX	alphabetical identifier
Reflectivity	XX	dBZ (integer)
Resolution	X.XX	nmi
Shear	XX	10/s, 10/s
Speed of storm motion	XX.X	kts
Time (GMT)	HH:MM:SS	hour, min, sec
Turbulence	XX.X	cm ^{2/3} s
Velocity Spectrum Width	XX	kts (integer)
Wind direction	DDD	degrees (integer)
Wind speed	XX	kts (integer)

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TABLE II. PRODUCT PARAMETERS

		RPG	SCREEN SELECT	RANGE/ RESOL	DATA LEVELS	ELEV. ANGLE	LAYER OR ALTITUDE	DISPLAY CENTER	CONTOUR INTERVAL	ALPHA TABULAR	ALPHA ANNOTATE	OVERLAY		
NTR1	BASE REFLECTIVITY	X	X	X	X	X								
NTR2	MEAN RADIAL VELOCITY	X	X	X	X	X								
NTR3	SPECTRUM WIDTH	X	X	X		X							X	
NTR4	COMBINED SHEAR	X	X			X							X	
NTR5	Deleted													
NTR6	COMPOSITE REFLECTIVITY	X	X	X	X								X	
NTR7	Deleted													
NTR8	ECHO TOPS	X	X										X	
NTR9	Deleted													
NTR10	SEVERE WEATHER ANALYSIS	X	X			X		X					X	
NTR11	SEVERE WEATHER PROBABILITY	X	X									X	X	
NTR12	VELOCITY AZIMUTH DISPLAY	X	X				ALTITUDE						X	
NTR13	Deleted													
NTR14	CROSS SECTION	X	X			AZIMUTH PTS.							X	
NTR15	Deleted													
NTR16 a)	STORM RELATIVE MEAN RADIAL VELOCITY REGION	X	X			X		X					X	X
NTR16 b)	STORM RELATIVE MEAN RADIAL VELOCITY MAP	X	X			X							X	X
NTR17	VERTICALLY INTEGRATED LIQUID	X	X										X	
NTR18	STORM TRACKING INFORMATION	X	X							X	X	X	X	
NTR19	HAIL INDEX	X	X							X	X	X	X	
NTR20	MESOCYCLONE	X	X							X	X	X	X	
NTR21	TORNADO VORTEX SIGNATURE	X	X							X	X	X	X	
NTR22	STORM STRUCTURE	X	X							X				
NTR23	LAYER COMPOSITE REFLECTIVITY	X	X	X			LAYER						X	
NTR24	Deleted													
NTR25	USER ALERT MESSAGE	X								X				
NTR26	RADAR CODED MESSAGE	X								X				
NTR27	FREE TEXT MESSAGE	X								X				
NTR28	SURFACE RAINFALL ACCUMULATION	X		X									X	
NTR29	STORM TOTAL RAINFALL ACCUMULATION	X		X									X	
NTR30	HOURLY DIGITAL PRECIPITATION ARRAY	X								X				
NTR31	SUPPLEMENTAL PRECIPITATION DATA	X								X				
NTR 32	USER SELECTABLE RAINFALL ACCUMULATION	X	X										X	
NTR 33	HYBRID SCAN REFLECTIVITY													
a)	DIGITAL HYBRID SCAN REFLECTIVITY	X												
b)	HYBRID SCAN REFLECTIVITY	X	X	X	X	X				X				
NTR34	CLUTTER FILTER CONTROL	X	X										X	
NTR35	ITWS Digital Base Velocity Array	X				X								
NTR36	CLUTTER LIKELIHOOD REFLECTIVITY	X	X			X					X			
NTR37	CLUTTER LIKELIHOOD DOPPLER	X	X			X					X			
NTR38	SUPEROB	X												
NTR39	DIGITAL HIGH RESOLUTION VERTICALLY INTEGRATED LIQUID	X	X											
NTR40	USER SELECTABLE LAYER COMPOSITE REFLECTIVITY	X	X				LAYER						X	
NTR41	DIGITAL HIGH RESOLUTION ENHANCED ECHO TOPS (HREET)	X	X	X	X									
NTR42	ONE HOUR SNOW ACCUMULATION	X	X	X	X					X	X		X	
NTR43	STORM TOTAL SNOW ACCUMULATION	X	X	X	X					X	X		X	
NTR44	USER SELECTABLE SNOW ACCUMULATION	X	X	X	X					X	X		X	

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NOTE: ALL PRODUCTS ARE GENERATED (AS FREQUENTLY AS ONE PER VOLUME SCAN) BASED ON

- 1) PUP ROUTINE PRODUCT SETS (RPS) LISTS
- 2) RPG PRODUCT GENERATION AND DISTRIBUTION LIST
- 3) ONE-TIME PRODUCT REQUEST
- 4) PAIRED PRODUCT/ALERT WHEN ALERT THRESHOLD/CATEGORIES ARE MET OR EXCEEDED
EXCEPTIONS
- 1) RADAR CODED MESSAGE GENERATED ONCE OR TWICE AN HOUR (UCP OPTION)
- 2) USER ALERT MESSAGE & FREE TEST MESSAGE GENERATED AS REQUIRED

NOTES: A) RANGE SELECTION IS SYNONYMOUS WITH RESOLUTION SELECTION. ONLY NTR1 (BASE REFLECTIVITY) HAS A RESOLUTION CHANGE WITH NO CHANGE IN AREA COVERAGE (0 - 248 NMI PRODUCT).

B) BACKGROUND MAPS MAY BE DEFAULTED FOR EACH PRODUCT. BACKGROUND CHANGES ARE ACCOMPLISHED (BY THE USER) AFTER THE DEFAULT PRODUCT SELECTION IS DISPLAYED.

TABLE III. STANDARD ABBREVIATIONS

Background Maps	Display Annotations
Airport	AP
Airway High	AH
Airway Low	AL
City	CI
County/State	CO/ST
Highways	HY
LFM Grid	LF
Military Operations Area	MO
Navigation Aids	NA
Instrument Landing System	ILS
Non-Directional Beam	NDB
VHF Omni-Directional Range	VOR
VHF Omni-Directional Range/Directional Measuring Equipment	VORDME
VHF Omni-Directional Range/Tactical Air Navigation	VORTAC
Prohibited Area	PA
Radar Site	PS
Restricted Area	RA
River	RV
River Basin	RB
Warning Area	WA
<u>Operational Mode</u>	Display Annotations
Clear Air Mode	B
Precipitation Mode	A
Overlays	Display Annotations
Alert Grid 1	A1
Alert Grid 2	A2
Annotations	AN
Attribute	AT
Hail Index	HI
Mesocyclone	M
Mesocyclone Rapid Update	MRU
Severe Weather Probability	SW
Storm Track	ST
TVS	TV
SS Products	Abbreviations
Combined Shear	CS
Composite Reflectivity	CR
Cross Section	RCS, VCS
Echo Tops	ET
Free Text Message	FTM

Background Maps	Display Annotations
Hail Index	HI
Hourly Digital Precipitation Array	DPA
Hybrid Scan Reflectivity	HSR
Layer Composite Reflectivity (Average, Maximum, Anomalous Propagation Removed)	LRA, LRM, APR
Layer Composite Turbulence (Average, Maximum)	LTA, LTM
Mean Radial Velocity	V
Mesocyclone	M
Mesocyclone Detection	MDA
Digital Mesocyclone Detection	DMD
One-Hour Rainfall Accumulation	OHP
One-Hour Snow Water Equivalent	OSW
One-Hour Snow Depth	OSD
PUP Text Message	PTM
Radar Coded Message	RCM
Reflectivity	R
Severe Weather Analysis Display	SWA (SWR, SWV OR SRR, SWW, SWS)
Severe Weather Probability	SWP
Spectrum Width	SW
Storm Relative Mean Radial Velocity Map	SRM
Storm Relative Mean Radial Velocity Region	SRR
Storm Structure	SS
Storm Total Rainfall Accumulation	STP
Storm Total Snow Water Equivalent	SSW
Storm Total Snow Depth	SSD
Storm Tracking Information	STI
Supplemental Precipitation Data	SPD
Three-Hour Rainfall Accumulation	THP
Tornado Vortex Signature	TVS
Tornado Vortex Signature Rapid Update	TRU
User Alert Message	UAM*
User Selectable Layer Composite Reflectivity	ULR
User Selectable Snow Water Equivalent	USW
User Selectable Snow Depth	USD
Velocity Azimuth Display	VAD
Vertical Wind Profile	VWP
Vertically Integrated Liquid	VIL
Above Ground level	AGL
Alphanumeric	A/N
Azimuth	AZ
Azimuth/Range	AZLAN

Background Maps	Display Annotations
Center Point	C/P
Cathode Ray Tube	CRT
Centered	CTRD
10 log (Rainfall Accumulation/mm)	dBA
10 log (Equivalent Reflectivity)	dBZ
degree	deg
Diameter	DIAM
Digital Video Integrator and Processor	DVIP
Elevation	ELEV
Elevated TVS	ETVS
Error	ERR
Feature	FEAT
Federal Meteorological Handbook	FMH
feet	ft
Forecast	FCST
Greenwich Mean Time	GMT
height	Hgt
Identification Number	ID
Interface Control Document	ICD
Interval	INT
kilofeet	Kft
knots	kts
Limited Fine Mesh	LFM
Maximum Reflectivity	MAX Z
Maximum Spectrum Width	MAX WIDTH
Maximum Velocity	MAX VEL
Mean Sea Level	MSL
National Weather Service	NWS
nautical miles	nmi
NEXRAD Technical Requirements	NTR
Next Generation Weather Radar	NEXRAD
No Data	ND
Not Applicable	N/A
Orientation	ORI
Overhang	OVH
Overlay	OVLA
Positive	YES
Principle User External Systems	PUES
Principle User Processor	PUP
Probable	PBL
Radar Data Acquisitions	RDA
Radar Product Generation	RPG
Radial	RAD
Range Folding	RF
Root Mean Square	RMS
Rotation	ROT
Routine Product Set	RPS
second(s)	s
Signal-to-Noise Ratio	SNR

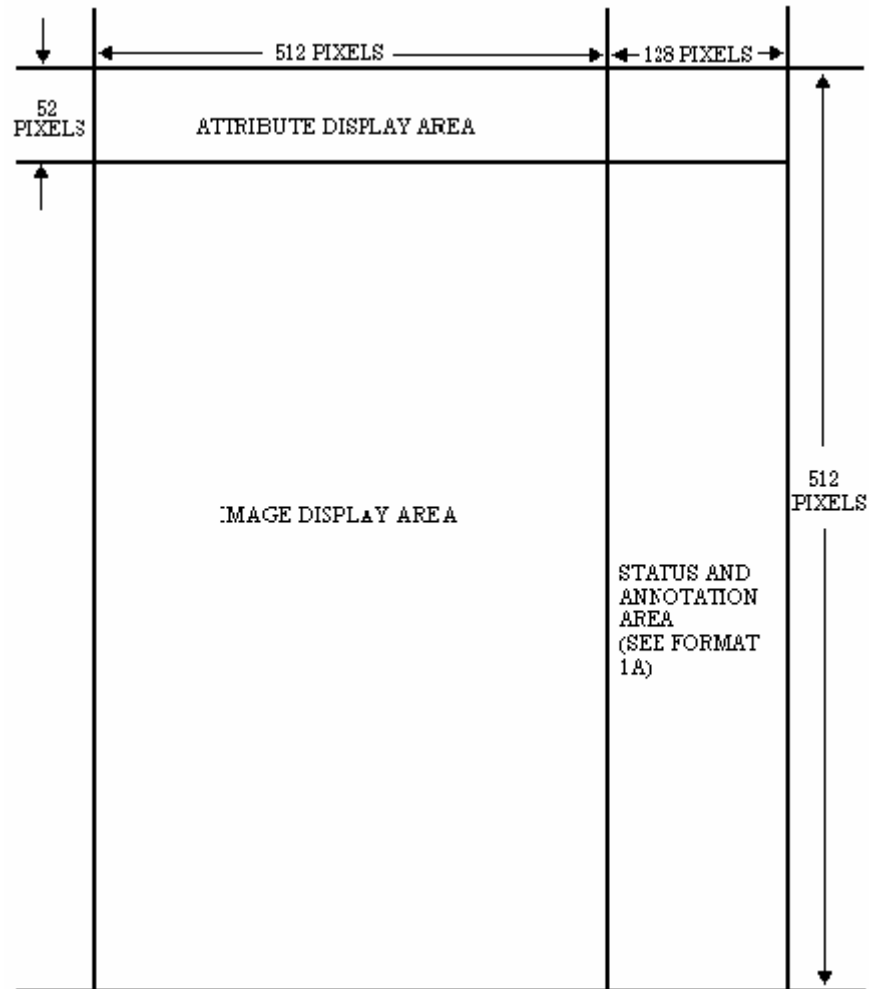
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Background Maps	Display Annotations
System Specification	SS
Storm	STM
Surface	SFC
To Be Determined	TBD
Unit Control Position	UCP
Unknown	UNK
Variance	VAR
Video Integrated Processor	VIP
Volume	VOL

* A complete listing of alert abbreviations used in the UAM appears in section 8.3.1 of PUP/RPGOP User's Manual.

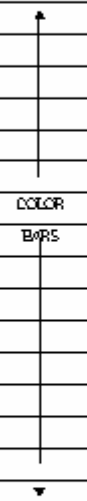

APPENDIX B

Graphic Display Formats



FORMAT (FULL SCREEN DISPLAY)

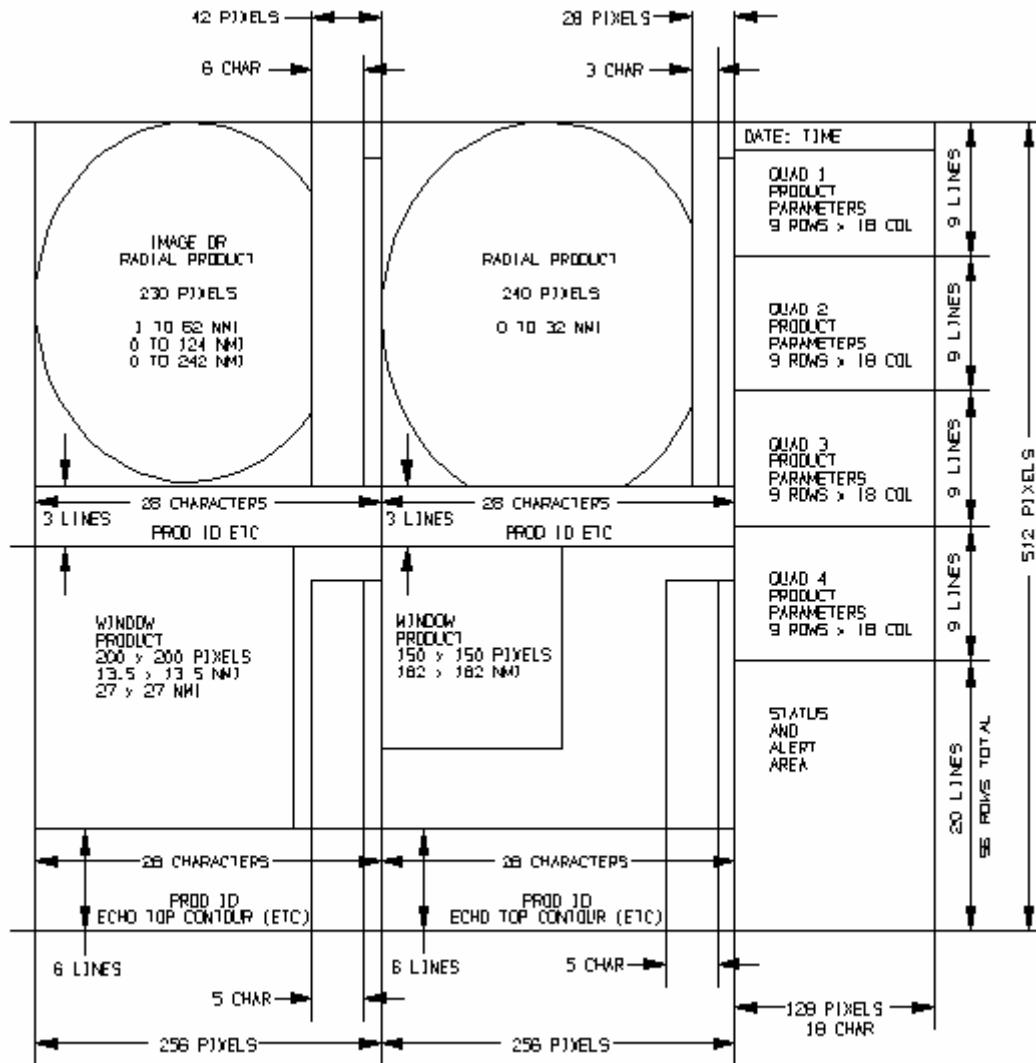
Format I. Full Screen

1.	CURRENT DATE AND TIME	
2.	PRODUCT NAME, ID NUMBER, AND ID NUMBER	
3.	PRODUCT RESOLUTION AND/OR COVERAGE AREA	
4.	PRODUCT VOLUME, SCAN DATE, AND TIME	
5.	RADAR ID NUMBER WITH ELEVATION AND POSITION (LATITUDE AND LONGITUDE)	(2 LINES)
6.	PRODUCT ELEVATION AND ALTITUDE	
7.	OPERATIONAL MODE AND VOLUME COVERAGE PATTERN	
8.	CENTER COORDINATES OF THE CURRENT DISPLAY	
9.	PRODUCT DEPENDENT DATA (MAXIMUM DATA LEVELS) NOTE: CONTOUR INTERVAL, STORM DIRECTION, SPEED, AND ALTITUDE	(2 LINES)
10.	<div> <div>  </div> <div> <div> <div>UNITS</div> <div>  </div> </div> </div> </div>	
11.	MAGNIFICATION, FILTER LEVEL, AND COMBINE NUMBER	
12.	OVERLAYS DISPLAYED	(2 LINES)
13.	OVERLAYS NOT AVAILABLE	(2 LINES)
14.	POLAR GRID DRIVING INTERVAL AND ANGLE	
15.	BACKGROUND MAPS NOT AVAILABLE	(2 LINES)
16.	TIME LAPSE AUTO DISPLAY RATE	
17.	CURSOR HEIGHT AND COORDINATES (LATITUDE AND LONGITUDE OR AZIMUTH/RANGE)	(2 LINES)
18.	PRODUCT QUEUE STATUS	
19.	RPO PRODUCT STATUS	(2 LINES)
20.	SYSTEM STATUS	(2 LINES)
21.	GRAPHIC TABLET SELECTION	(2 LINES)
22.	FEEDBACK	(2 LINES)
23.	WEATHER ALERTS (UNACKNOWLEDGED AND ACKNOWLEDGED)	(3 LINES)

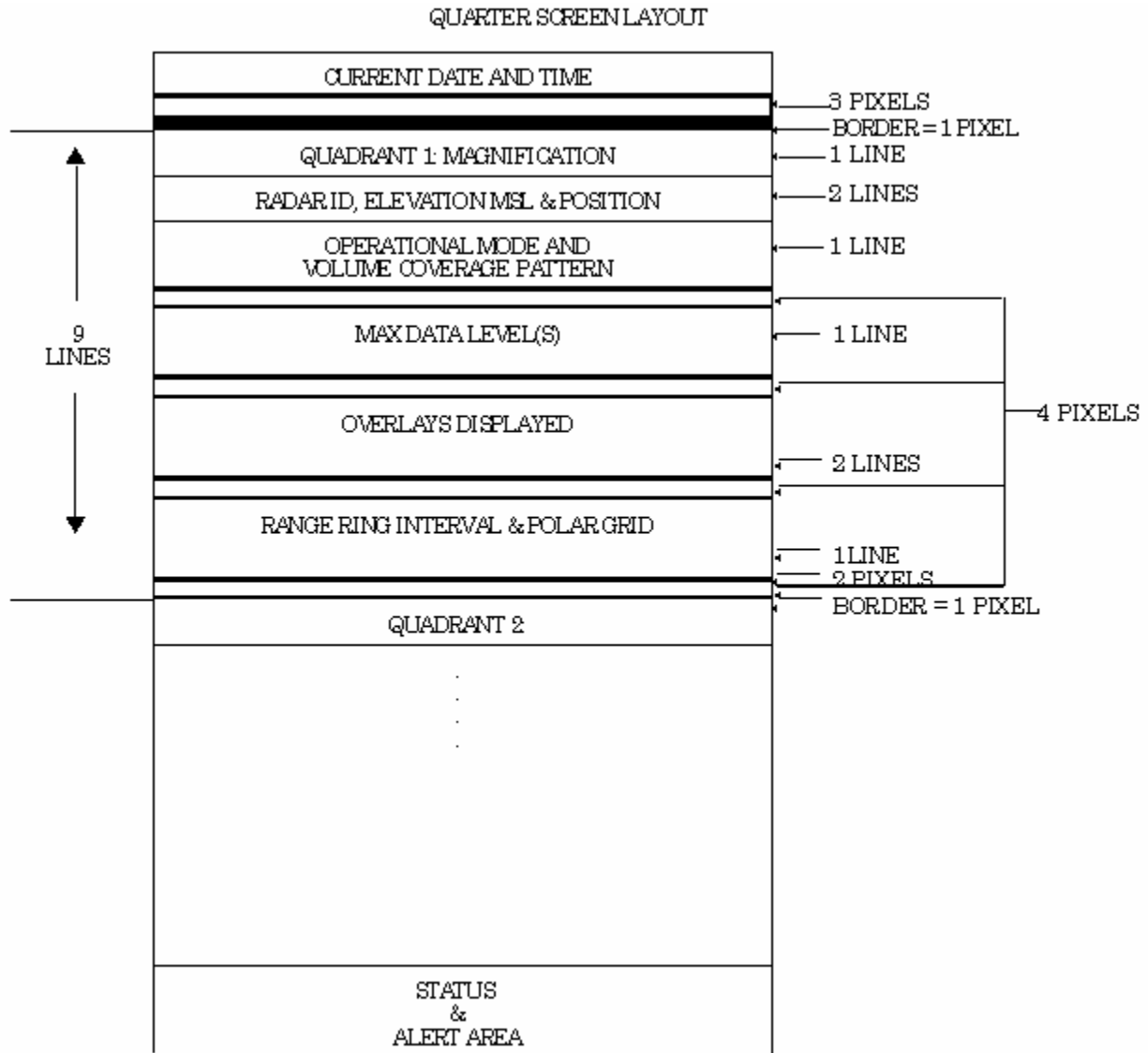
Format Ia. Full Screen (Status and Annotation Area)
STATUS AND ANNOTATION AREA (PARAMETER SELECT MODE)

		CHARACTER																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
YELLOW			CURRENT DATE AND TIME																1 LINE	
GREEN		1	PRODUCT NAME, MNEMONIC & ID NUMBER																2 LINES	
		2																		
		3																	2 LINES	
		4																		
		5	DATE ELEMENTS OR CENTOUR INDEX/4																↑	
		6	RDSY LUTION																	
WHITE		7	ELEVATION OR AZIMUTH OR ALTITUDE																	
		8	COURSE AZIMUTH																	
		9	COURSE RANGE																	
		10	STORM SPEED																	
		11	STORM DIRECTION																	
		12	REG. MNEMONIC																	1 LINE
GREEN		13	TIME																↓	
		14	DATE																	
CYAN		15	PRIORITY																	
		16	REPEAT COUNT																	
		17	REQUEST Mbps																	
		18																		
		19	CURRENT PARAM CODE																	
		20	CURRENT PARAMETER NAME, EDITED																	
YELLOW		21	PREVIEW AREA																	
YELLOW REVERSE VIDEO		22	4 SIN NORM. MODE STARTS WITH PRODUCT QUEUE STATUS (DOWN)																	
	23																			
	24																			
	25																			
	26																			
	27																			
	28																			
	29																			

Format Ib. Status and Annotation Area (Parameter Select Mode)



QUARTER SCREEN
Format II. Quarter Screen



Format IIa: Quarter Screen Layout

QUARTER SCREEN LAYOUT BENEATH NON-WINDOW PRODUCTS

<div> <div>↑</div> <div>3</div> <div>LINES</div> <div>↓</div> </div>	PRODUCT NAME WITH COVERAGE AREA AND/OR RESOLUTION	
	PRODUCT DATE AND TIME	PRODUCT DISPLAY CENTER
	ELEVATION ANGLE OR AZIMUTH	STORM MOTION

BENEATH WINDOW PRODUCTS

<div> <div>↑</div> <div>6</div> <div>LINES</div> <div>↓</div> </div>	PRODUCT NAME WITH COVERAGE AREA AND/OR RESOLUTION	
	PRODUCT DATE AND TIME	PRODUCT DISPLAY CENTER
	ELEVATION ANGLE OR AZIMUTH	STORM MOTION
	ALERT TYPE	HEIGHT OF PHENOMENA

Format IIb. Quarter Screen Window/Non-Window Products

CONF 1	STORM ID	XX		NTR 18 STORM TRACKING INFORMATION								
	AZ RAN	XXX XXX		NOTE: STORMS ARE ORDERED ACCORDING TO: 1) CELL-BASED VIL AND 2) MAXIMUM REFLECTIVITY								
	FCST MVT	XXXXXX XX										
	TRACK ERR	XX.X XX.X										
	DBZM HGT	XX.X XX.X										
CONF 2A	STORM ID	XX		NTR 20 MESOCYCLONE								
	FEATURE	XXXXXXXX		FEATURES ARE 1. MESO (MESOCYCLONE)								
	AZ RAN	XXX XXX		2. 3 DC SHR (3D CORRELATED SHEAR)								
	BASE TOP	XX.X XX.X		NOTE: STORMS WITH MESOCYCLONE ARE GIVEN DISPLAY PRIORITY								
	RAD AZ DIA	XX.X XX.X										
CONF 2B	STATUS/ID	XXX / XX		NTR 20B MESOCYCLONE RAPID UPDATE								
	FEATURE	XXXXXXXX^		FEATURES ARE 1. MESO (MESOCYCLONE)								
	AZ RAN	XXX ^ XXX		2. 3 DC SHR (3D CORRELATED SHEAR)								
	BASE TOP	XX.X^XX.X		NOTE: STORMS WITH MESOCYCLONES HAVE PRIORITY								
	RAD AZDIA	XX.X^XX.X										
CONF 2C	CIRC ID	XXX		NTR 20 MESOCYCLONE DETECTION								
	SR LLRV	XXa XXX										
	AZ RAN	XXX XXX										
	HGT MXRV	XX XX										
	BASE DPTH	<XX >XX		NOTE: CIRCULATIONS LISTED FROM HIGHEST TO LOWEST STRENGTH RANK.								
CONF 3A	TYPE STM ID	XXXX XX		NTR 21 TVS								
	AZ RAN	XXX XXX		TYPES ARE 1. TVS								
	AVGDV	XXX		2. ETVS (Elevated TVS)								
	LLDV MDV	XXX XXX		NOTE: TVSs are listed before ETVSs, and both types are ordered by Low-level Delta Velocity (from highest to lowest).								
	BASE DEPTH	XXX.X XX										
CONF 3B	TYPE STID	XXXX ^ XX		NTR 21 TVS								
	AZ RAN	XXX ^XXX		TYPES ARE 1. TVS								
	LLDV MDV	^XXX ^XXX		2. ETVS (Elevated TVS)								
	STA AVGDV	XXX ^XXX		NOTE: TVSs are listed before ETVSs, and both types are ordered by Low-level Delta Velocity (from highest to lowest).								
	BASE DPTH	<XX.X^>XX										
CONF 4	STORM ID	XX		NTR 19 HAIL								
	AZ RAN	XXX XXX		NOTE: STORMS ARE ORDERED ACCORDING TO: 1) PROBABILITY OF SEVERE HAIL AND 2) PROBABILITY OF HAIL								
	POSH/POH	XXX/XXX										
	MAX HAIL SIZE	XX.XX										
	0/-20 C TEMP ALT XX.X/XX.X KFT(MSL) - LAST CHANGE HH/MM DD/MM/YY											
CONF 5	STM ID	AZ RAN	TVS	MESO	POSH/POH/MX SIZE	VIL	DBZM HGT	TOP	FCST	MVMT	COMBINED ATTRIBUTE TABLE	
	XX	XXX XXX	XXX	XXX	XXX	XX	XX XXX	XX.XX	XXX	XX		
CONF 6	GAGE BIAS - APPLIED											NTR 32 USP
	XX OF YY HOURS IN PRODUCT											
	END TIMES	XXZ										
	BIAS	Y.YY										
	HOURS INCLUDED?	YES/NO										

NOTE:STORM CELLS ORDERED: TVSs, ETVS, MESOs, 3-D CORRELATED SHEARS, 2-D UNCORRELATED SHEARS, POSH, POH, AND CELL-BASED VIL.
NOTE:THE STORM CELL TOP(TOP) DATA IS QUALIFIED WITH '>' IF THE CELL WAS DETECTED ON THE HIGHEST ELEVATION SCAN OF THE VOLUME COVERAGE PATTERN.

GENERAL NOTES: 1 ALL HORIZONTAL AND VERTICAL LINES SEPARATING THE PARAMETERS ARE ONE PIXEL WIDE.
2 LETTER SIZES (ALL A/N) FIT INTO A 7 X 9 PIXEL AREA.

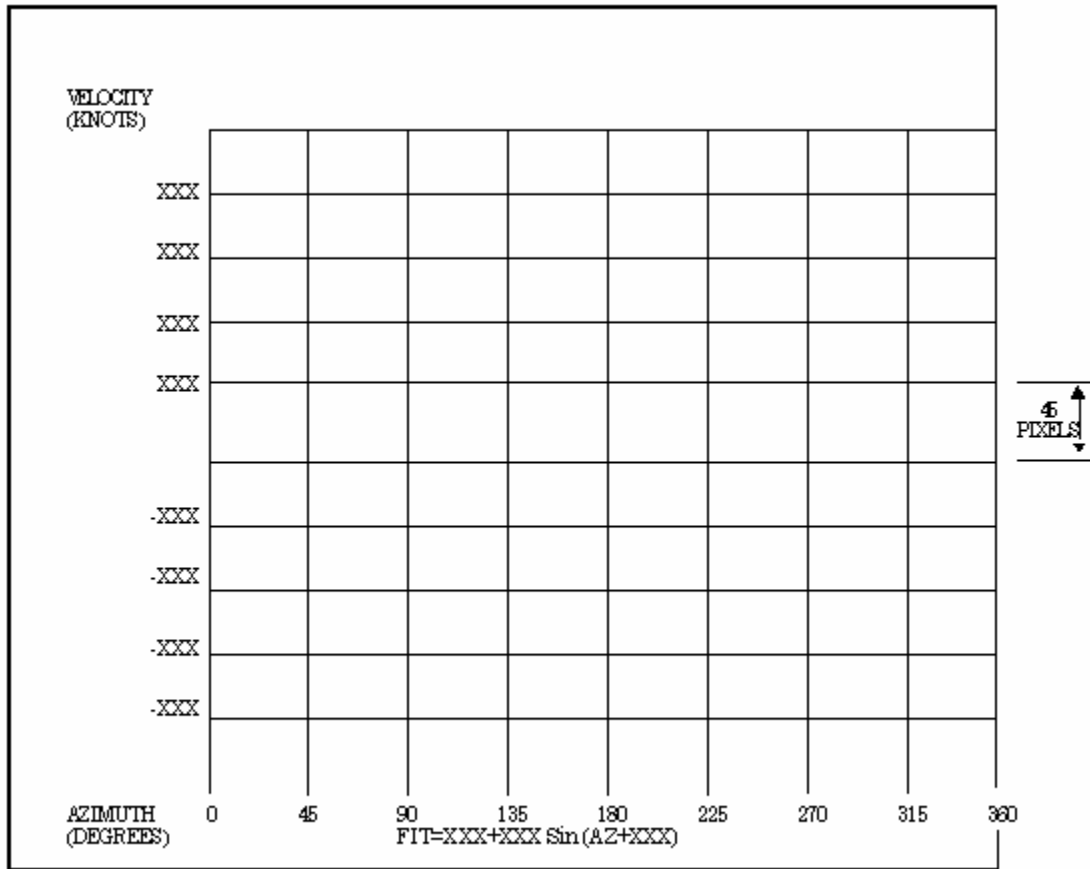
Format III. Attribute Area

[illegible]

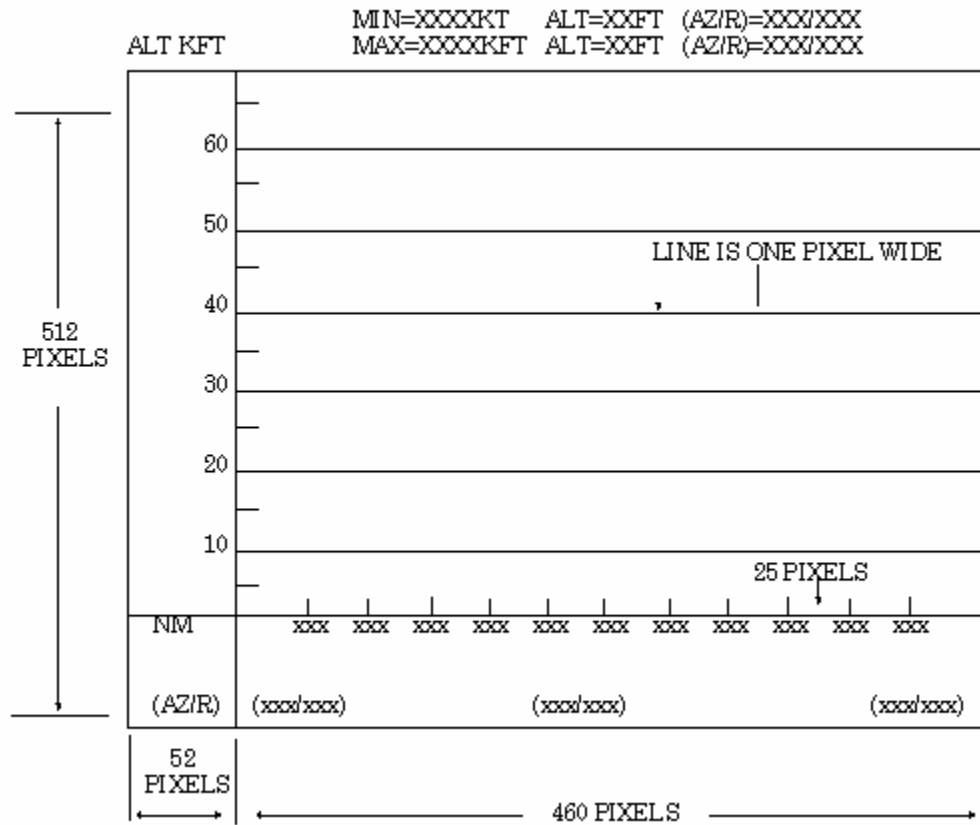
VWP GRID

NOTE 1:THE NUMBER OF PIXELS BETWEEN HORIZONTAL HEIGHT LINES IS A FUNCTION OF THE NUMBER OF UCP SELECTED HEIGHTS (THE MINIMUM NUMBER IS 14 PIXELS)

Format IVA VWP Grid



VAD WIND ANALYSIS GRID
Format IVb. VAD Grid



Format V. Cross-Section Grid

ALPHANUMERIC PORTION OF RCM (10 LINES OF 70 CHARACTERS)		PRODUCT NAME, DATE AND TIME, ETC	
PARAMETER SELECT AREA	INTERMEDIATE GRAPHIC PRODUCT PORTION OF RCM		COLOR BAR
MENU SELECT AREA			STATUS AND ALERT AREA

Format VII. RCM Edit Screen

APPENDIX C

Alphanumeric Tabular Formats

- Storm Tracking
- Hail Index
- Mesocyclone
- TVS
- Storm Structure
- Supplementary Precipitation Data
- Hourly Digital Precipitation Array
- Digital Hybrid Scan Reflectivity
- Precipitation Adaptation Data
- Wind Profile adaptable Parameter
- Clutter Likelihood Adaptation Data
- One-Hour and Storm Total Snow Accumulation
- User Selectable Snow Accumulation

STORM POSITION/FORECAST

RADAR ID:	nnn	DATE/TIME	MM:DD:YY:HH:MM:SS	NUMBER OF STORMS	nnn		
		CURRENT POSITION		FORECAST POSITION			ERROR
STORM ID	AZRAN (DEG/NM)	MOVEMENT (KEG/KTS)	15 MIN (DEG/NM)	30 MIN (DEG/NM)	45 MIN (DEG/NM)	60 MIN (DEG/NM)	FAST/MEAN (NM)
XX	XXX/XXX	XXX/XXX	XXX/XXX	XXX/XXX	XXX/XXX	XXX/XXX	XX.X/XX.X

NOTE:STORMS ARE ORDERED ACCORDING TO: 1) MAXIMUM CELL-BASED VIL AND 2) MAXIMUM REFLECTIVITY.

NOTE:THE NUMBER OF STORM CELLS DISPLAYED FROM THE TOP OF THE ORDERED LIST IS ADAPTABLE AT THE UCP.

Format I. Storm Tracking

STORM CELL TRACKING/FORECAST ADAPTATION DATA

XXX (DEG)	DEFAULT (DIRECTION)	X.X (M/S)	THRESH (MINIMUM SPEED)
XX.X (KTS)	DEFAULT (SPEED)	XX (KM)	ALLOWABLE ERROR
XX (MIN)	TIME (MAXIMUM)	XX (MIN)	FORECAST INTERVAL
XX	NUMBER OF PAST VOLUMES	X	NUMBER OF INTERVALS
XX.X (M/S)	CORRELATION SPEED	XX (MIN)	ERROR INTERVAL

Format I. Storm Tracking

HAIL

RADAR ID	nnn	DATE/TIME	MM:DD:YY:HH:MM:SS	NUMBER OF STORM CELLS
STORM ID	PROBABILITY OF SEVERE HAIL (%)	PROBABILITY OF HAIL (%)	MAX EXPECTED HAIL SIZE (IN)	nnn
XX	XXX	XXX	XX.XX	

NOTE: STORMS ARE ORDERED ACCORDING TO: 1) PROBABILITY OF SEVERE HAIL AND 2) PROBABILITY OF HAIL.

NOTE: THE NUMBER OF STORM CELLS DISPLAYED FROM THE TOP OF THE ORDERED LIST IS ADAPTABLE AT THE UCP.

Format II. Hail Index

HAIL DETECTION ADAPTATION DATA

XX.X	(KFT)	HEIGHT (0 DEG CELSIUS)	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #1
XX.X	(KFT)	HEIGHT (-20 DEG CELSIUS)	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #2
X.XE-XX		HKE COEFFICIENT #1	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #3
XXX		HKE COEFFICIENT #2	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #4
XX.X		HKE COEFFICIENT #3	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #5
XX.X		POSH COEFFICANT	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #6
XX	(%)	POSH OFFSET	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #7
.XX		SHI HAIL SIZE COEFFICIENT	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #8
.X		SHI HAIL SIZE EXPONENT	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #9
XX	(DBZ)	THR HKE REF WGT LOWER LIM	\	X.XXX	(KM)	POH HEIGHT DIFFERENCE #10
XX	(DBZ)	THR HKE REF WGT UPPER LIM	\	XX	(DBZ)	THR MIN REFLECTIVITY POH
XX	(%)	THRESH(RCM PROBABLE HAIL)	\	XX	(1%)	THRESH(RCM POSITIVE HAIL)
XX.X	10E2	J/M**2(S)WTSM COFFICIENT	\	-XX.X	(10E5 J/MS)	WTSM OFFSET
XXX	(KM)	MAX HAIL PROCESSING RANGE	\			

Format II Hail Index

MESOCYCLONE

RADAR ID NNN		DATE/TIME MM:DD:YY/HH:MM:SS			NUMBER OF STORMS NN				
FEAT	STOR	FEAT	BASE	TOP	AZRAN	HGT	DIAM	(NM)	SHEAR (E-
ID	ID	TYPE	KFT	KFT	DEG-NM	KFT	RAD	AZ	3/S)
XX	XX	MESO	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
XX	XX	MESO	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
XX	XX	MESO	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
XX	XX	3DC	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
		SHR							
XX	XX	3DC	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
		SHR							
XX	XX	UNC	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
		SHR							
XX	XX	UNC	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
		SHR							
XX	XX	UNC	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
		SHR							
XX	XX	UNC	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
		SHR							

Format III. Mesocyclone

MESOCYCLONE ADAPTATION PARAMETERS

MIN	# PATTRN	VEC	XX	
MAX	HGT MESO		X.X	KM
HGH	MOMENTUM THR		XXX.X	KM**2/HR
LOW	MOMENTUM THR		XXX.X	KM**2/HR
HGH	SHR THR		XX.X	1/HR
LOW	SHR THR		X.X.X	1/HR
MAX	DIAM RATIO THR		X.X	
FAR	MAX DIAM RATIO THR		X.X	
MIN	DIAM RATIO THR		X.X	
FAR	MIN DIAM RATIO THR		X.X	
RANGE	FAR MAX/MIN		XXX.X	KM
MAX	RADIAL DIFFERENCE		X.X	KM
MAX	AZIMUTHAL DIFFERENCE		X.X	DEG

Format III Mesocyclone

TORNADO VORTEX SIG

RADAR ID NNN		DATE/TIME MM:DD:YY/HH:MM:SS		NUMBER OF TVS/ETVS NNN/NNN					
Feat Type	Feat ID	Storm ID	AZ/RAN (deg,nm)	AVGDV (kt)	LLDV (kt)	MXDV/Hgt (kt,kft)	Depth (kft)	Base/Top (kft)	MXSHR/Hgt (m/s/km,kft)
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X
HHHH	XX	HH	XXX/XXX	XXX	XXX	XXX/XX.X	XXX.X	XXX.X/XXX.X	XXX/XX.X

MESOCYCLONE RAPID UPDATE

RADAR ID: NNN				DATE: MM/DD/YY		TIME: HH:MM:SS		Elev: xx.x deg	
FEATURE STATUS	STORM ID	FEATURE TYPE	BASE kft	TOP kft	AZRAN deg-nm	HGT kft	DIAM RAD	(NM) AZ	SHEAR (E- 3/S)
EXT	XX	MESO	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
PER	XX	MESO	HH.H^	HH.H	DDD/XXX^	HH.H	XXX	XXX	XXX
INC	XX	MESO ^	HH.H^	HH.H	DDD/XXX^	HH.H	XXX	XXX	XXX
INC	XX	3DC SHR	HH.H^	HH.H	DDD/XXX^	HH.H^	XXX^	XXX	XXX^
INC	XX	3DC	HH.H^	HH.H	DDD/XXX^	HH.H^	XXX^	XXX	XXX^
EXT	XX	SHR^							
EXT	XX	UNC SHR	HH.H	HH.H	DDD/XXX^	HH.H	XXX	XXX	XXX
XXX	XX	UNC SHR	HH.H	HH.H^	DDD/XXX	HH.H	XXX	XXX	XXX
XXX	XX	UNC SHR	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
XXX	XX	UNC SHR	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX
XXX	XX	UNC SHR	HH.H	HH.H	DDD/XXX	HH.H	XXX	XXX	XXX

Format IIIb. Mesocyclone Rapid Update (Sheet 1 of 1)

MESOCYCLONE DETECTION ALGORITHM

RADAR ID: NNN		DATE: MM/DD/YY HH:MM:SS		TIME:		Avg dir/spd: XXX/XXX			
CIRC ID	AZRAN deg/nm	SR	-LOW LEVEL- RV DV BASE		--DEPTH-- kft STMREL%		-MAX RV- kft kts		TVS X
XXX	XXX/XXX	XXa	XX	XX	<XX	>XX	XX	XX	X
									XXX/XXX
									XXXXXX

Format IIIc. Mesocyclone Detection (Sheet 1 of 1)

TORNADO VORTEX SIGNATURE ADAPTATION PARAMETERS

0(DBZ)	.. .MIN REFELECTIVITY	2.5(KM)	.. .CIRCULATION RADIUS #1
11(M/S)	.. .VECTOR VELOCITY DIFFERENCE	4.0(KM)	.. .CIRCULATION RADIUS #2
100(KM)	.. .MAX PATTERN VECTOR RANGE	80(KM)	.. .CIRCULATION RADIUS RANGE
10.0(KM)	.. .MAX PATTERN VECTOR HEIGHT	600	.. .MAX # OF 2D FEATURES
2500	.. .MAX # OF PATTERN VECTORS	3	.. .MIN # OF 2D FEAT/ 30 FEATURE
11(M/S)	.. .DIFFERENTIAL VELOCITY #1	1.5(KM)	.. .MIN 3D FEATURE DEPTH
15(M/S)	.. .DIFFERENTIAL VELOCITY #2	25(M/S)	.. .MIN 3D FEAT LOW-LVL DELTA VEL
20(M/S)	.. .DIFFERENTIAL VELOCITY #3	36(M/S)	.. .MIN TVS DELTA VELOCITY
25(M/S)	.. .DIFFERENTIAL VELOCITY #4	35	.. .MAX # OF 3D FEATURES
30(M/S)	.. .DIFFERENTIAL VELOCITY #5	15	.. .MAX # OF TVSS
35(M/S)	.. .DIFFERENTIAL VELOCITY #6	20	.. .MAX # OF ELEVATED TVSS
3	.. .MIN # OF VECTORS/ 2D FEATURE	0.6(KM)	.. .MIN TVS BASE HEIGHT
0.5(KM)	.. .2D VECTOR RADIAL DISTANCE	1.0(DEG)	.. .MIN TVS ELEVATION
1.5(DEG)	.. .2D VECTOR AZIMUTHAL DIST	3.0(KM)	.. .MIN AVG DELTA VELOCITY HGT
4.0(KM/KM)	.. .2D FEATURE ASPECT RATIO	20.0(KM)	.. .MAX STORM ASSOCIATION DIST

Format IV. TVS

Document Number 2620003H
Code Identification 0WY55
WSR-88D ROC
29 July 2004
Open Build 6.0

TVS Rapid Update									
RADAR ID: nnn		DATE: mm/dd/yy		TIME: hh:mm:ss		TVS/ETVS: >xx/>xx		ELEV: xx.x	
FEATURE		STORM		Base/Top					
STAT TYPE		ID	AZ/RAN (deg,nm)	AVGDV (kt)	LLDV (kt)	MXDV/Hgt (kt,kft)	Depth (kft)		MXSHR/Hgt (E-3/s, kft)
XXX	TVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	TVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	TVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	TVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	ETVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	ETVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	ETVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^
XXX	ETVS^	XX	XXX/XXX^	XXX	XXX^	XXX/XX.X^	>XX.X	<XX.X/>XX.X^	XXX/XX.X^

Format IVb. TVS Rapid Update

STORM STRUCTURE

RADAR ID NNN DATE/TIME MM:DD:YY/HH:MM:SS

STORM	AZ/RAN	BASE KFT	TOP	CELL BASED	MAX REF	HEIGHT
ID	(DEG,NM)		KFT	VIL	DBZ	KFT
				KG/M**2		
XX	XXX/XXX	XX.X	XXX.X	XXX	XX	XX.X

NOTE: The Storm Cell Top (TOP) and Storm Cell Base are the height above ground level (AGL).

NOTE: The Storm Top (TOP) data is qualified with '>' if the cell was detected on the highest elevation scan of the Volume Coverage Pattern.

NOTE: The Storm Cell Base (BASE) data is qualified with '<' if the cell was detected on the lowest elevation scan of the Volume Coverage Pattern.

NOTE: Will display the 40 most intense Storm Cells

NOTE: Storm Cells ordered according to Cell-based VIL and secondly Maximum Reflectivity

Format V. Storm Structure

SUPPLEMENTAL PRECIPITATION DATA - RDA ID XXX MM/DD/YY HH:MM
VOLUME COVERAGE PATTERN = XXXX MODE = X TIME CONT = {PASSED, FAILED}
GAGE BIAS APPLIED - {YES,NO}
BIAS ESTIMATE - {XXX.XX}
EFFECTIVE # G/R PAIRS - {XXX.XX}
MEMORY SPAN (HOURS) - {XXXXXXXXXX.XX}
DATE/TIME LAST BIAS UPDATE - {MM/DD/YY HH:MM}
TOTAL NUMBER OF...
BLOCKAGE BINS REJECTED - {XXXXXX}
CLUTTER BINS REJECTED - {XXXXXX}
FINAL BINS SMOOTHED - {XXXXXX}

HYBRID SCAN
PERCENT BINS FILLED -{XXX.XX}
HIGHEST ELEV. USED (DEG) -{XX.XX}
TOTAL RAIN AREA (KM**2) -{XXXXXXXX.XX}
MISSING RADAR PERIODS - NONE or {MM/DD/YY HH:MM to
mm/dd/yy hh:mm}

FORMAT VI SPD (Sheet 1 of 2)

GAGE-RADAR MEAN FIELD BIAS TABLE
LAST BIAS UPDATE TIME:MM/DD/YY HH:MMBIAS APPLIED? {YES/NO}

MEMORY SPAN (HOURS)	EFFECTIVE NO. G-R PAIRS	AVG. GAGE VALUE (MM)	AVG. RADAR VALUE (MM)	MEAN- FIELD BIAS
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX
XXXXXXXXXX.XX	XXX.XXX	XXX.XXX	XXX.XXX	XXX.XXX

FORMAT VI. SPD (sheet 2 of 2)

DATA FORMAT: (TIME(HH:MM), VALUE(INCHES), DURATION(MINUTES))

GAGE ID: XXXX TYPE: {ACC;INC} LAT: XX.XX LON: XXX.XX AZ: XXX.X RNG: XXX.X #RPTS: XX

Variable Description	Format	Range	Units	Default
(PPS ADAPTATION DATA)	{ADAP(nn)}			
Beam Width	{XXXXXX.XX}	0.8 - 1.0	DEG	0.9
Blockage Threshold	{XXXXXX.XX}	0.0 - 100.0	%	50.0
Clutter Threshold	{XXXXXX.XX}	0 - 100	%	75
Weight Threshold	{XXXXXX.XX}	0.0 - 100.0	%	50.0
Full Hybrid Scan Threshold	{XXXXXX.XX}	90.0 - 100.0	%	99.7
Low Refl. Threshold	{XXXXXX.XX}	-40 - -20	DBZ	-32.0
Rain Detection Refl. Threshold	{XXXXXX.XX}	10 - 30	DBZ	20.0
Rain Detection Area Threshold	{XXXXXX.XX}	0 - 82800	KM**2	80
Rain Detection Time Threshold	{XXXXXX.XX}	0 - 1440	MIN	60
Z-R Mult. Coef.	{XXXXXX.XX}	50.0 - 500.0	--	300.0
Z-R Power Coef.	{XXXXXX.XX}	1.0 - 2.0	--	1.4
Min Refl. to convert to Rate	{XXXXXX.XX}	-32.0 - 20.0	DBZ	0.0
Max Refl. to convert to Rate	{XXXXXX.XX}	50.0 - 90.0	DBZ	70.0
Number Exclusion Zones	{XXXXXX.XX}	0 - 20	--	0
Max Storm Speed	{XXXXXX.XX}	10 - 40	M/S	25.0
Thresh. Max Time Difference	{XXXXXX.XX}	10.0 - 30.0	MIN	15.0
Min. Area Time Continuity	{XXXXXX.XX}	50 - 1000	KM**2	200.0
Time Continuity Parameter #1	{XXXXXX.XX}	0.1 - 99.9	1/HR	24.0
Time Continuity Parameter #2	{XXXXXX.XX}	0.1 - 99.9	1/HR	13.2
Max. Rate Echo Area Change	{XXXXXX.XX}	20 - 700	KM**2/HR	200.0
Range Cut-Off	{XXXXXX.XX}	0 - 230	KM	230.0
Range Effect Coeff. #1	{XXXXXX.XX}	0.0 - 3.0	dBR	0.0
Range Coeff. Coeff. #2	{XXXXXX.XX}	1.0 - 10.0	-	1.0
Range Coeff. Coeff. #3	{XXXXXX.XX}	0.0 - 1.0	-	0.0
Min Precip. Rate for inclusion	{XXXXXX.XX}	0.0 - 10.0	MM/HR	0.0
Max Precip. Rate allowed	{XXXXXX.XX}	50 - 1600	MM/HR	103.8
Thresh. Elapsed Time to Restart	{XXXXXX.XX}	45 - 60	MIN	60.0
Max. Time for Interpolation	{XXXXXX.XX}	15 - 60	MIN	30.0
Min. Time in Hourly Period	{XXXXXX.XX}	0 - 60	MIN	54.0
Threshold Hourly Outlier	{XXXXXX.XX}	50 - 800	MM	400.0
End Time Gage Accumulation	{XXXXXX.XX}	0 - 59	MIN	0.0
Max Period Accum Value	{XXXXXX.XX}	50 - 400	MM	400.0
Max Hourly Accum Value	{XXXXXX.XX}	50 - 1600	MM	800.0
Time Bias Estimation	{XXXXXX.XX}	50 - 59	MIN	50.0
Thresh. No. Gage-Radar Pairs	{XXXXXX.XX}	6 - 30	-	10
Reset Bias Value	{XXXXXX.XX}	0.5 - 2.0	-	1.0
Longest Allowable Lag	{XXXXXX.XX}	100 - 1000	HOURS	168
Bias Applied Flag	{T or F}	T - F	-	F
(BIAS TABLE DATA)	{BIAS(nn)}			
(Same as Appendix C, Format VI, SPD, sheet 2)				
(PPS SUPPLEMENTAL DATA)	{SUPL(nn)}			
Rate Scan 1	Date: {XXXXXXXXXX} Time: {XXXXXXXXXX}			
.				
.				
Rate Scan nn	Date: {XXXXXXXXXX} Time: {XXXXXXXXXX}			
(Note: nn can range from 2 to 16)				

Variable Description	Format	Range	Units	Default
Hourly Accumulation End Date	{XXXXXXXX}			
Hourly Accumulation End Time	{XXXXXXXX}			
Total No. of Blockage Bins Rejected	{XXXXXXXX}			
Total No. of Clutter Bins Rejected	{XXXXXXXX}			
Number of Bins Smoothed	{XXXXXXXX}			
Percent of Hybrid Scan Bins Filled	{XXXXX.XX}			
Highest Elevation Angle Used	{XXXXX.XX}			
Total Hybrid Scan Rain Area	{XXXXXXXX}			
Number of Bad Scans in Hour	{XXXXXXXX}			
Bias Estimate	{XXXXX.XX}			
Effective No. Gage-Radar Pairs	{XXXXX.XX}			
Memory Span (Hours)	XXXXXXXX.XXX			
Current Volume Coverage Pattern	{XXXXXXXX}			
Current Operational (Weather) Mode	{XXXXXXXX}			
No Missing Periods in Current Hour				

NOTE 1: The alphanumeric data package of the DPA product (#81) is contained in the last layer of the product, which can range from layer #2 to layer #15, depending on the number of layers of RLE-formatted Rate Scans which precede it (i.e., 0-13). It is formatted using Text and Special Symbols Packet Code 1: Write Text (No Value). (See RPG/Associated PUP ICD for details.) It contains two "sub-layers" of information: Adaptation Data and Supplemental Data. Each sub-layer is preceded by an 8-character field containing a mnemonic for the data type followed by the number of elements of that type to follow (i.e., "ADAP(nn)", then "SUPL(nn)").

NOTE 2: The Adaptation Data sub-layer contains **values only** (i.e., no preceding descriptive information), but the values are always **listed** in the **exact order** seen above. Each value is given in a field of 8 ASCII characters, as seen in the "Format" column (which, alone, contains the entire contents of the Adaptation Data sub-layer of the product). The meaning of each field can be ascertained from the additional columns, above.

NOTE 3: The Supplemental Data sub-layer contains values along with preceding descriptive information. Up to 80 ASCII characters are used for the description and value of each field. The number in parentheses following the mnemonic "SUPL" (e.g., 27) refers to the number of elements of information to follow.

Format VII. DPA

Variable Description	Format	Range	Units	Default
(PRECIP STATUS MESSAGE DATA)	{PSM (nn)}			
Last Date Precip Function Ran	{XXXXXXXXXX}	0 - 99999	JULIAN DAYS	--
Last Time Precip Function Ran	{XXXXXXXXXX}	0 - 86399	SEC	--
Last Date Precip Detected	{XXXXXXXXXX}	0 - 99999	JULIAN DAYS	--
Last Time Precip Detected	{XXXXXXXXXX}	0 - 86399	SEC	--
Current Precip Category	{XXXXXXXXXX}	0, 1 or 2	--	--
Previous Precip Category	{XXXXXXXXXX}	0, 1 or 2	--	--
(PPS ADAPTATION DATA)	{ADAP (nn) }			
Beam Width	{XXXXXX.XX}	0.8 - 1.0	DBZ	0.9
Blockage Threshold	{XXXXXX.XX}	0.0 - 100.0	%	50.0
Clutter Threshold	{XXXXXX.XX}	0 - 100	%	75
Weight Threshold	{XXXXXX.XX}	0.0 - 100.0	%	50.0
Full Hybrid Scan Threshold	{XXXXXX.XX}	90.0 - 100.0	%	99.7
Low Refl. Threshold	{XXXXXX.XX}	-40 - -20	DBZ	-32
Rain Detection Refl. Threshold	{XXXXXX.XX}	10.0 - 30.0	DBZ	20.0
Rain Detection Area Threshold	{XXXXXX.XX}	0 - 82800	KM**2	80
Rain Detection Time Threshold	{XXXXXX.XX}	0 - 1440	MIN	60
Z-R Mult. Coef.	{XXXXXX.XX}	50.0 - 500.0	--	300.0
Z-R Power Coef.	{XXXXXX.XX}	1.0 - 2.0	--	1.4
Min Refl. to convert to Rate	{XXXXXX.XX}	-32.0 - 20.0	DBZ	0.0
Max Refl. to convert to Rate	{XXXXXX.XX}	50.0 - 90.0	DBZ	70.0
Number Exclusion Zones	{XXXXXX.XX}	0 - 20	-	0
Max Storm Speed	{XXXXXX.XX}	10 - 40	M/S	25.0
Thresh. Max Time Difference	{XXXXXX.XX}	10.0 - 30.0	MIN	15.0
Min. Area Time Continuity	{XXXXXX.XX}	50 - 1000	KM**2	200.0
Time Continuity Parameter #1	{XXXXXX.XX}	0.1 - 99.9	1/HR	24.0
Time Continuity Parameter #2	{XXXXXX.XX}	0.1 - 99.9	1/HR	13.2
Max. Rate Echo Area Change	{XXXXXX.XX}	20 - 700	KM**2/HR	200.0
Range Cut-Off	{XXXXXX.XX}	0 - 230	KM	230.0
Range Effect Coeff. #1	{XXXXXX.XX}	0.0 - 3.0	dBR	0.0
Range Coeff. Coeff. #2	{XXXXXX.XX}	1.0 - 10.0	-	1.0
Range Coeff. Coeff. #3	{XXXXXX.XX}	0.0 - 1.0	-	0.0
Min Precip. Rate for inclusion	{XXXXXX.XX}	0.0 - 10.0	MM/HR	0.0
Max Precip. Rate allowed	{XXXXXX.XX}	50 - 1600	MM/HR	103.8
Thresh. Elapsed Time to Restart	{XXXXXX.XX}	45 - 60	MIN	60.0
Max. Time for Interpolation	{XXXXXX.XX}	15 - 60	MIN	30.0
Min. Time in Hourly Period	{XXXXXX.XX}	0 - 60	MIN	54.0
Threshold Hourly Outlier	{XXXXXX.XX}	50 - 800	MM	400.0
End Time Gage Accumulation	{XXXXXX.XX}	0- 59	MIN	0.0
Max Period Accum Value	{XXXXXX.XX}	50 - 400	MM	400.0
Max Hourly Accum Value	{XXXXXX.XX}	50 - 1600	MM	800.0
Time Bias Estimation	{XXXXXX.XX}	50 - 59	MIN	50.0
Thresh. No. Gage-Radar Pairs	{XXXXXX.XX}	6 - 30	-	10
Reset Bias Value	{XXXXXX.XX}	0.5 - 2.0	-	1.0
Longest Allowable Lag	{XXXXXX.XX}	100-1000	HOURS	168
Bias Applied Flag	{ T or F }	T - F	-	F
SUPPLEMENTAL DATA (EPRE ALG))	{SUPL(nn)}			
Hybrid Scan Date	{XXXXXXXXXX}	0 - 99999	JULIAN DAYS	--
Hybrid Scan Time	{XXXXXXXXXX}	0 - 86399-	SEC	-
Flag Zero Hybrid	{XXXXXXXXXX}	0 or 1	--	--
Flag Rain Detected	{XXXXXXXXXX}	0 or 1	--	--
Flag Reset Storm Total	{XXXXXXXXXX}	0 or 1	--	--
Flag Precip Begin	{XXXXXXXXXX}	0 or 1	--	--
Last Date Rain	{XXXXXXXXXX}	0 - 99999	JULIAN DAYS	--
Last Time Rain	{XXXXXXXXXX}	0 - 86399	SEC	--
Total No. of Blockage Bins Rejected	{XXXXXXXXXX}	0 - 99999	--	--
Total No. of Clutter Bins Rejected	{XXXXXXXXXX}	0 - 99999	--	--
Total Bins Smoothed	{XXXXXXXXXX}	0 - 99999	--	--
Percent Hybrid Scan Filled	{XXXXXX.XX}	0.0 - 100.0	%	--
Highest Elev. Angle Used in Hybrid Scan	{XXXXXX.XX}	0.0 - 19.5	DEG	--
Hybrid Scan Rain Area	{XXXXXX.XX}	0.0 - 99999	KM**2	--

Variable Description	Format	Range	Units	Default
Spot-Blanking Volume Status Flag (BIAS-RELATED FIELDS)	{XXXXXXXX} {BIAS(nn)}	0 or 1	--	--
Last Date Local Bias Value Updated	{XXXXXXXX}	0-99999	JULIAN DAYS	--
Last Time Local Bias Value Updated	{XXXXXXXX}	0-86399	SEC	--
Last Date Local Bias Table Updated	{XXXXXXXX}	0-99999	JULIAN DAYS	--
Last Time Local Bias Table Updated	{XXXXXXXX}	0-86399	SEC	--
Observation Date of Last Bias Table	{XXXXXXXX}	0-99999	JULIAN DAYS	--
Observation Time of Last Bias Table	{XXXXXXXX}	0-86399	SEC	--
Generation Date of Last Bias Table	{XXXXXXXX}	0-9999	JULIAN DAYS	--
Generation Time of Last Bias Table	{XXXXXXXX}	0-86399	SEC	--
Mean-Field Bias Estimate	{XXXXXXX}	.01-100		
Effective G-R Pair Sample Size	{XXXXXXX}	0.00-999.99	---	
Memory Span used in Bias Estimate	{XXXXXXX.XXX}	0.001-10.**7	--	

NOTE 1: The alphanumeric data package of the DHR product (#32) and the DSP product (#138) is contained in the last (i.e., 2nd) layer of the product. It is formatted using Text and Special Symbols Packet Code 1: Write Text (No Value). (See RPG/Associated PUP ICD for details.) It contains four "sub-layers" of information: Precipitation Status Message parameters, Adaptation Data, Supplemental Data (Precipitation Preprocessing Algorithm only), and Bias-related parameters. Each sub-layer is preceded by an 8-character field containing a mnemonic for the data type followed by the number of elements of that type to follow (i.e., "PSM (nn)", followed by "ADAP(nn)", "SUPL(nn)" and "BIAS(nn)").

NOTE 2: The alphanumeric data sub-layer contains **values only** (i.e., no preceding descriptive information), but the values are always **listed** in the **exact order** seen above. Each value is given in a field of 8 ASCII characters, as seen in the "Format" column (which, alone, contains the entire contents of the alphanumeric data sub-layer of the product). The meaning of each field can be ascertained from the additional columns, above.

Format VIII. DHR and DSP

RADAR HALF POWER BEAM WIDTH.	0.9 DEG
MAXIMUM ALLOWABLE PRECENT OF BEAM BLOCKAGE.	50.00 %
MAXIMUM ALLOWABLE PERCENT LIKELIHOOD OF CLUTTER.	75.00 %
PERCENT OF BEAM REQUIRED TO COMPUTE AVERAGE POWER.	50.00 %
PERCENT OF HYBRID SCAN NEEDED TO BE CONSIDERED FULL.	99.7 %
LOW REFLECTIVITY THRESHOLD (dBZ) FOR BASE DATA.	-32.00 DBZ
REFLECTIVITY (dBZ) REPRESENTING SIGNIFICANT RAIN.	20.00 DBZ
AREA WITH REFLECTIVITY EXCEEDING SIGNIFICANT RAIN THRESHOLD. .	80.00 KM**2
THRESHOLD TIME WITHOUT RAIN FOR RESETTNG STP.	60.00
. .	MINUTES
REFLECT-TO-PRECIP RATE CONVERSION MULTIPLICATIVE COEFFICIENT. .	300.00
REFLECT-TO-PRECIP RATE CONVERSION POWER COEFFICIENT.	1.40
MIN DBZ FOR CONVERTING TO PRECIP RATE (VIA TABLE LOOKUP) . . .	0.00 DBZ
MAX DBZ FOR CONVERTING TO PRECIP RATE (VIA TABLE LOOKUP).	70.00 DBZ
NUMBER EXCLUSION ZONES.	0

Format IX Precipitation Adaptation Data (sheet 1 of 4)

MAX STORM SPEED (M/SEC)	25.00 M/SEC
MAX SCAN -TO-SCAN TIME DIFFERENCE FOR TIME CONTINUITY TESTS. . .	15.00 MINUTES
MIN PRECIP-AREA FOR PERFORMING TIME CONTINUITY TESTS	200.00 KM**2
RATE OF CHANGE : VOLUMETRIC PRECIP RATE, MIN ECHO AREA	24.00 1/HR
RATE OF CHANGE : VOLUMETRIC PRECIP RATE, FULL ECHO UMBRELLA . .	13.20 1/HR
MAX ECHO-AREA RATE OF CHANGE	200.00
	KM**2/HR
RANGE BEYOND WHICH TO APPLY RANGE-EFFECT CORRECTION	230.00 KM
1 ST COEFFICIENT OF RANGE-EFFECT FUNCTION	0.00 DBR
2 ND COEFFICIENT OF RANGE-EFFECT FUNCTION	1.00
3 RD COEFFICIENT OF RANGE-EFFECT FUNCTION	0.00
MIN RATE SIGNIFYING PRECIPITATION	0.00 MM/HR
MAX PRECIPITATION RATE	103.80 MM/HR

Format IX Precipitation Adaptation Data (sheet 2 of 4)

REINITIALIZATION TIME LAPSE THRESHOLD (FOR ACCUM PROCESS) ..	60.00 MINUTES
MAX TIME DIFFERENCE BETWEEN SCANS FOR INTERPOLATION.	30.00 MINUTES
MIN TIME NEEDED TO ACCUMULATE HOURLY TOTALS.	54.00 MINUTES
THRESHOLD FOR HOURLY OUTLIER ACCUMULATION.	400.00
....	MINUTES
HOURLY GAGE ACCUMULATION SCAN ENDING TIME.	0.00 MINUTES
MAX ACCUMULATION PER SCAN TO SCAN PERIOD.	400.00
....	MINUTES
MAX ACCUMULATION PER HOURLY PERIOD.	800.00
....	MINUTES

Format IX Precipitation Adaptation Data (sheet 3 of 4)

MINUTES AFTER CLOCK HOUR WHEN BIAS IS UPDATED.	50.00
	MINUTES
THRESHOLD # OF GAGE/RADAR PAIRS NEEDED TO SELECT BIAS FROM	10.00
TABLE.	
RESET VALUE OF GAGE/RADAR BIAS ESTIMATE.	1.00
LONGEST TIME LAG FOR USING BIAS VALUE FROM TABLE.	168. HOURS
BIAS FLAG	FALSE

Note: The column labels are described as follows:

Format IX Precipitation Adaptation Data (sheet 4 of 4)

VAD Algorithm Output MM/DD/YY HH:MM

[illegible]

Note: The column labels are described as follows:

ALT- Altitude above mean sea level in hundreds of feet:

U, V - Eastward, northward components of the wind in m/s;

W- Upward component of the wind in cm/s;

DIR - Standard wind direction in degrees;

SPD - Standard wind speed in knots;

RMS - Scatter between velocity points and the VAD fitted curve in knots;

DIV- Divergence of the wind in 10 per second;

SRNG - Slant range of the VAD analysis in nautical miles;

ELEV - Elevation angle of the VAD analysis in degrees;

Format X for VAD Wind Data to VWP Tabular Alphanumeric Block (TAB) (Sheet 1 of 3)

VAD Algorithm Output MM/DD/YY HH:MM

ADAPTABLE PARAMETERS - WIND PROFILE

VAD ANALYSIS SLANT RANGE	16.2	NMI
BEGINNING AZIMUTH ANGLE	0.0	DEGREE
ENDING AZIMUTH ANGLE	0.0	DEGREE
NUMBER OF PASSES	2	
RMS THRESHOLD	9.7	KNOTS
SYMMETRY THRESHOLD	13.6	KNOTS
DATA POINTS THRESHOLD	25	

Format X Wind Profile Adaptable Parameters (Sheet 2 of 3)

ALTITUDES SELECTED

2000	3000	4000	5000	6000	7000
8000	9000	10000	11000	12000	13000
14000	15000	16000	17000	18000	19000
20000	21000	22000	24000	25000	26000
28000	30000	35000	40000	45000	50000
OPTIMUM SLANT RANGE				16.2	

Format X Wind Profile Adaptable Parameters (Sheet 3 of 3)

Radar Echo Classifier Adaptation Data

Variable Description	Format	Range	Units	Default
AP/Clutter Target Scaling Function Thresholds:				
Texture of Reflectivity generating a 0% likelihood	XX.X	0.0 – 80.0	DBZ**2	0.0
Texture of Reflectivity generating a 100% likelihood	XX.X	0.0 – 80.0	DBZ**2	45.0
Abs. value of Sign of Refl. Change generating a 0% likelihood	X.X	0.0 – 1.0	--	1.0
Abs. value of Sign of Refl. Change generating a 100% likelihood	X.X	0.0 – 1.0	--	0.0
Abs. value of (Refl. Spin Change – 50) generating a 0% likelihood	XXX.X	0.0 – 100.0	--	50.0
Abs. value of (Refl. Spin Change – 50) generating a 100% likelihood	XXX.X	0.0-100.0	--	0.0
Abs. value of Mean Velocity generating a 0% likelihood	XX.X	0.0 - 10.0	m/s	2.3
Abs. value of Mean Velocity generating a 100% likelihood	XX.X	0.0-10.0	m/s	0.0
Standard Deviation of Velocity generating a 0% likelihood	X.X	0.0 - 5.0	m/s	0.7
Standard Deviation of Velocity generating a 100% likelihood	X.X	0.0-5.0	m/s	0.0
Mean Spectrum Width generating a 0% likelihood	X.X	0.0 - 5.0	m/s	3.2
Mean Spectrum Width generating a 100% likelihood	X.X	0.0 - 5.0	m/s	0.0
AP/Clutter Target Spin Characteristic Thresholds:				
Spin Change Threshold	XX.X	0.0 - 20.0	--	2.0
Spin Reflectivity Threshold	XX.X	0.0 - 20.0	DBZ	5.0
AP/Clutter Target Category Weighting:				
Texture of Reflectivity weight	X.XX	0.0 - 1.0	--	1.0
Sign of Reflectivity Change weight	X.XX	0.0 - 1.0	--	1.0
Reflectivity Spin Change weight	X.XX	0.0 - 1.0	--	1.0
Mean Velocity weight	X.XX	0.0 - 1.0	--	1.0
Standard Deviation of Velocity weight	X.XX	0.0 - 1.0	--	1.0
Mean Spectrum Width weight	X.XX	0.0 - 1.0	--	1.0
Extents for Radial Processing:				
Azimuthal Extent	X	1-4	Radials	1
Reflectivity Range Extent	X	1-4	Bins	2
Doppler Range Extent	X	1-8	Bins	4

Format XI Radar Echo Classifier Adaptable Parameters (Sheet 1 of 1)

[product name] ¹	([product mnemonic])
RPG Name: XXXX Date: MM/DD/YYYY Time: HH:MMZ ²	
Starting Date:.....	MM/DD/YYYY
Starting Time:.....	HH:MMZ ²
Ending Date:.....	MM/DD/YYYY
Ending Time:.....	HH:MMZ ²
Maximum Snow Depth:...	X.XX inches ³
Azimuth of Maximum Value:.....	XXX degrees
Range to Maximum Value:.....	XXX nautical miles
Range/height Correction Applied:	Static
Missing Time:.....	XXX minutes

NOTE 1: Product names and product mnemonics are “ONE HOUR SNOW WATER EQUIVALENT (OSW)”, “ONE HOUR SNOW DEPTH (OSD)”, “STORM TOTAL SNOW WATER EQUIVALENT (SSW)”, and “STORM TOTAL SNOW DEPTH (SSD)”, “USER SELECTABLE SNOW WATER EQUIVALENT (USW)”, and “USER SELECTABLE SNOW DEPTH (USD)”.

NOTE 2: Times are in UTC and are followed by a “Z”.

NOTE 3: One Hour Snow Water Equivalent (OSW) and Storm Total Snow Water Equivalent (SSW) products will have the “Maximum Snow Water Equivalent” listed instead of the “Maximum Snow Depth”.

FORMAT XII One-hour and Storm Total Snow Accumulation (sheet 1 of 2)

Snow Accumulation Algorithm Configuration Parameters

RPG Name: XXXX Date: MM/DD/YYYY Time: HH:MMZ	
Z-S Multiplicative Coefficient.....	XXX.X
Z-S Power Coefficient.....	X.X
Snow - Water Ratio.....	XX.X in/in
Minimum Reflectivity/Isolated Bin Threshold.....	X.X dBZ
Maximum Reflectivity/Outlier Bin Threshold.....	XX.X dBZ
Base Elevation for Default Range Height Correction.....	X.X deg
Minimum Height Correction Threshold.....	X.X km
Range Height Correction Coefficient #1.....	X.XXXX
Range Height Correction Coefficient #2.....	X.XXXX
Range Height Correction Coefficient #3.....	X.XXXX
Time Span Threshold.....	XX min
Minimum Time Threshold.....	XX min
Use RCA Correction Flag (RCA Currently Not Available).....	XXX

FORMAT XII One-hour and Storm Total Snow Accumulation (sheet 2 of 2)

[product name]¹ ([product mnemonic])
RPG Name: XXXX Date: MM/DD/YYYY Time: HH:MMZ²
Starting Date:..... MM/DD/YYYY
Starting Hour:..... HH:MMZ²
Ending Date:..... MM/DD/YYYY
Ending Hour:..... HH:MMZ²
Maximum Snow Depth:..... X.XX inches³
Azimuth of Maximum Value:..... XXX degrees
Range to Maximum Value:..... XXX nautical miles
Range/height Correction Applied: Static
End Hour Requested:..... HHZ²
No. of Hours Requested:..... XX
Available Hours:..... XX⁴
HHZ² HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ HHZ

NOTE 1: Product names and product mnemonics are “USER SELECTABLE SNOW WATER EQUIVALENT (USW)”, and “USER SELECTABLE SNOW DEPTH (USD)”.

NOTE 2: Times are in UTC and are followed by a “Z”.

NOTE 3: The User Selectable Snow Water Equivalent (USW) product will have the “Maximum Snow Water Equivalent” listed instead of the “Maximum Snow Depth”.

NOTE 4: For the list of available hours, all available hours (in UTC) are listed, even if the hours aren’t included in the product due to the number of hours requested. Up to 30 hours can be listed.

FORMAT XIII User Selectable Snow Accumulation (sheet 1 of 2)

Snow Accumulation Algorithm Configuration Parameters
RPG Name: XXXX Date: MM/DD/YYYY Time: HH:MMZ
Z-S Multiplicative Coefficient..... XXX.X
Z-S Power Coefficient..... X.X
Snow - Water Ratio..... XX.X in/in
Minimum Reflectivity/Isolated Bin Threshold..... X.X dBZ
Maximum Reflectivity/Outlier Bin Threshold..... XX.X dBZ
Base Elevation for Default Range Height Correction..... X.X deg
Minimum Height Correction Threshold..... X.X km
Range Height Correction Coefficient #1..... X.XXXX
Range Height Correction Coefficient #2..... X.XXXX
Range Height Correction Coefficient #3..... X.XXXX
Time Span Threshold..... XX min
Minimum Time Threshold..... XX min
Use RCA Correction Flag (RCA Currently Not Available)..... XXX

FORMAT XIII User Selectable Snow Accumulation (sheet 2 of 2)

APPENDIX D

RADAR CODED MESSAGE CODE

The Radar Coded Message, as described in Item 26, Appendix E of the NTR, NEXRAD Products, will be composed of three parts, preceded by a communications header. Part A, Reflectivity and Part B, VAD Winds, will be encoded automatically. Part C, Remarks, will be encoded automatically. In the groups below, capital letters represent the fixed part of the group, and small letters represent variables. The message will be encoded as follows:

Header

The header is encoded as follows:

ccc	The communications node (PUP site identifier)
ROBEE	The product category for edited radar coded message
ROBUU	The product category for unedited radar coded message
sidd (C/R)	Four-letter RDA site identifier [Example: cccROBEE sidd (C/R)]

Part A: Reflectivity

Part A of the Radar Coded Message (RCM) contains a tabular listing of alphanumerics. Data in the Radar Coded Message are located with respect to a polar stereographic grid. The local grid at each antenna site is designed to be a subset of the National Radar Grid so that data may be readily composited.

The National Radar Grid has a resolution of LFM (Limited Fine Mesh model) which is 47.625 km at 60 degrees north latitude. The vertical axis of the grid is parallel to the 105 degrees west longitude meridian.

At each site, a local grid is chosen having 25 rows and 25 columns, with the antenna site located within the central box. The 25 rows and columns of the grid are assigned letters A through Y, so that the box containing the antenna site is always box NM. Box AA is at the upper left. As shown in Figure D-1, each box is further subdivided to form an overall 1/16-LFM grid.

The graphic product contains reflectivity data for the 1/16-LFM grid over the radar area of coverage out to 248 nmi. The reflectivity intensity value for each grid box is determined by assigning the maximum value of all Reflectivity boxes whose centers are contained within the 1/16-LFM grid square.

The RCM is based on the 256-level, .54 nmi x 1 degree Composite or Hybrid Scan Reflectivity product but contains only nine data level categories; six for data within 124 nmi and one for missing or below threshold data and two for data beyond 124 nmi. Hybrid Scan Reflectivity data is used for the region within 124 nmi of the radar and Composite Reflectivity data is used for the region outside of 124 nmi. For data beyond 124 nmi, a separate threshold is provided for which: (a) all data above that threshold are labeled as level eight, and (b) all data below that threshold are labeled as level nine.

LOCAL ROW	LOCAL COLUMN								C	D
	A				B					
A	A	E	I	M	A	E	I	M		1/4 LFM Grid AD
	B	F	J	N	B	F	J	N		
	C	G	K	O	C	G	K	O		
	D	H	L	P	D	H	L	P		
B	A	E	I	M	A	E	I	M	{ 1/16 LFG Grid BBF	
	B	F	J	N	B	<div>7</div>	J	N		
	C	G	K	O	C	G	K	O		
	D	H	L	P	D	H	L	P		
C										
D										

Figure D-1. 1/16 Limited Fine Mesh Model Grid

Within the tabular listing, data are provided for the maximum echo top. The height, and the position where provided, are derived from the Echo Tops product. The listing also shows the locations of the largest centroids within 124 nmi of the radar using the 1/16-LFM grid and provides the forecast centroid speed and direction, as available from the Storm Position Forecast algorithm. Part A of the message is encoded as follows:

/NEXRAA	Part A indicator
sidd	Four-letter RDA site identifier
ddmmyytttt	The day (dd) of the month (mm), the year (yy), and the time (tttt), to the nearest minute, in Greenwich Mean Time (GMT)
edited	Status of message
or	
unedited	
RADNE	A group to encode no reportable reflectivity intensity values will be provided, i.e., field NInnn is zero. This will be corrected after graphic editing
RADOM	A group to encode radar down for maintenance will be provided
/MDnnnn	A group of six characters to encode operational mode will be provided. See Appendix I. Choices are PCPN and CLAR (Example: /MDPCPN)
/SCnnnn	A group of six characters to encode scan strategy will be provided. Refer to

Appendix I of the NTR. Choices are 1405 (14 scans in 5 minutes), 0906, 0510, etc.
(Example: /SC1405)

/NIInnnn The total number (nnnn) of intensities (NI) reported in the following field (gggi) will be encoded. This group will be corrected after editing, if editing is performed.
(Example: /NI0144)

gggi Reflectivity intensity will be mapped onto the 1/16-LFM grid (ggg). Encode locations and intensities by a series of groups made up of three letters (1/16-LFM followed by the maximum intensity of the designated grid box). The three letters (in order) will be row, column, and subgrid. The numbers following represent intensities in succeeding sub-grid boxes in that row; that is, encode each 1/16-LFM grid box from west to east, starting with the northern-most row with data, followed by the next southern row, etc. In the interest of compacting the message, successive intensities of different or similar values may be listed after a single location as long as the intensities are continuous. When succeeding grid boxes contain the same intensity value, the number of succeeding boxes with the same value may be designated by a letter of the alphabet that is, if four succeeding 1/16-LFM grid boxes (a total of five boxes) are at level 2, they could be coded as GGG2D. The "2D" may also be followed by different intensity values. Location/ intensity groups will be separated by a comma. (Example: ABF112D331 ,BCA1211)

/Mthhh:ggg The location and height (MSL) or the maximum echo top (MT) within 230 km radius of the radar will be encoded using the three letter grid designator (ggg) and assigning the height coinciding with echo top product in hundreds of feet (hhh).
(Example: /MT320:NLB)

NCENnn: The total number (nn) of centroids (NCEN) reported in this portion of the message will be encoded. This number will correspond to the corrected centroids below.
(Example: /NCEN04:)

Cnnggg dddfff The centroid (c) number (nn), location (grid box) (ggg), direction from which it is moving (in 1-degree increments) (ddd), and its speed (fff) in knots, will be encoded. Successive groups will be separated by commas. If, during editing, data are deleted in a grid box that contains a centroid, this group will be corrected by deleting this centroid. (Example: C03QMB240012)

/ENDAA(C/R) A group to indicate the end of Part A
The following is a summary example of the components of Part A:
/NEXRAA sidd 2812881330 Edited (C/R)
/Mdnnnn /SCnnnn /NIInnn:
gggi...i,gggi...i
/MThhh:ggg
/NCENnn: Cnnggg dddfff,Cnnggg dddfff
/ENDAA (C/R)

Part B: VAD Winds

Part B of the RCM contains a single profile of the horizontal wind information derived from the output of the VAD algorithm. Part B of the message is encoded as follows:

/NEXRBB	Part B indicator
sidd	Four-letter RDA site identifier
ddmmyytttt	The day (dd) of the month (mm), the year (yy), and the time (tttt), to the nearest minute, in GMT
VADNA	The optional entry VADNA will be encoded for instances when no VAD wind data available for the last 15 minutes, if appropriate
hhhcdddf	Coded heights (hhh) in hundreds of feet above MSL; confidence (c) level, using RMS for the coded height; wind direction (ddd) and wind speed (fff), in knots, will coincide with those derived from the VAD Winds product. The confidence level will be encoded as a single letter in accordance with the following:

A = RMS of 2 kts; B = RMS of 4 kts;
C = RMS of 6 kts; D = RMS of 8 kts;
E = RMS of 10 kts; F = RMS of 12 kts;
G = RMS of greater than or equal to 14 kts

Wind direction and speed, as Output from the VAD Algorithm, will be reported at up to 19 heights in feet above MSL. Default heights are:

1,000 6,000 12,000 25,000
2,000 7,000 14,000 30,000
3,000 8,000 16,000 35,000
4,000 9,000 18,000 50,000
5,000 10,000 20,000

(Example: 080C240060)

/ENDBB (C/R)End of Part B indicator

The following is a summary example of the components of Part B:

/NEXRBB sidd 2812881330 (C/R)
hhhcdddf, hhhcdddf, hhhcdddf
ENDBB (C/R)

Part C: Remarks

Part C of the Radar Coded Message contains remarks in an alphanumeric format. Automatically generated remarks provide information on the locations of tornado vortex signatures, mesocyclones, centroids, storm tops, and hail indices. The automated portion of Part C is encoded as follows:

/NEXRCC	Part C indicator
sidd	Four-letter RDA site identifier
ddmmyytttt	The day (dd) of the month (mm), the year (yy), and the time (tttt), to the nearest minute, in GMT
/NTVSnn:	The total number (nn) of Tornado Vortex Signatures (NTVS) detected by the TVS algorithm and reported in Part C will be encoded (Example: /NTVS03):
TVSnnngg	The location (ggg) and number identifier (nn) of each Tornado Vortex Signature (TVS) will be encoded using the three-letter grid box designator (Example: TVS02NLB)
/NMESnn:	The total number (nn) of Mesocyclones and areas of uncorrelated shear (NMES) detected by the Mesocyclone Detection algorithm and reported in Part C will be encoded (Example: /NMES05:)

Mnnnggg The location (ggg) and number identifier (nn) of each mesocyclone or area of uncorrelated shear (M) will be encoded using the three-letter grid box designator (Example: M03JLC).

/NCENnn: The total number (nn) of centroids (NCEN) reported in Part C will be encoded (Example: /NCEN08:)

Cnnnggg ShhhHi The height (hhh) in hundreds of feet (Above Ground Level (AGL)) of the storm top(s) as derived from the Storm Cell Centroids algorithm for each centroid 8 identified in Part A to include location (ggg) will be encoded. The centroid identifier number (nn) is the same as given in Part A. The hail (H) index (I), as provided by the Hail algorithm, is also given as one of the four following data levels:

- N - no hail (Probability of Severe hail(POSH) = <30%
- P - possible or probable hail (50%>POSH ≥ 30%)
- H - hail (POSH ≥ 50%)
- U - unknown

(Example: C04QQD S440HP).

In addition to the automatically generated remarks, Part C provides for optional manual entries. A template is provided containing the fixed part of the groups listed below. The only groups to be sent are those to which data are added. It should be noted that the absence of a remark does not imply that the phenomenon does not exist.

/PCTRyyyy,aaa:gg Precipitation type and intensity trend. Precipitation type (yyyy) may be coded for a representative area of the display. The type is variable and up to four characters in length. The intensity trend (aaa) is also variable in length and up to three characters in length. The location (gg) is reported using the two- letter identifier for the LFM grid.

For convective echo systems, the characteristic type of precipitation is defined as that type associated with the maximum observed intensity. For non-convective echo systems, the type of precipitation is defined as that type predominant in horizontal extent. If precipitation is reaching the surface, report that type.

Precipitation types are:

Precipitation	Symbol
Rain	R
Rain Shower	RW
Freezing Rain	ZR
Freezing Rain Shower	ZRW
Snow	S
Snow Shower	SW
Drizzle	L
Freezing Drizzle	ZL
Ice Pellet	IP
Ice Pellet Shower	IPW

Designate areas believed to be associated with thunderstorms with the symbol T preceding the precipitation symbol.

Evaluate the intensity trend in terms of the net change in the characteristic intensity during a period of 1 hour for lines and areas, and 15 minutes for cells.

Report the intensity trend as increasing (+) or decreasing (-), if, during the period, the net change in characteristic intensity (dBZe) changes from one intensity level to another.

If the net change in the characteristic intensity during the period does not change categories, report the intensity trend as NC (no change).

Report echo systems as NEW (new development) if they originated during the period specified above. Areas or lines that develop from a cell or cells during the hour preceding the report will be reported as NEW.

For a mixed system consisting of a liquid characteristic type of precipitation and a frozen secondary type, report the intensity trend of the liquid precipitation.

Intensity trend symbols are:

Symbol	Trend
+	Increasing
-	Decreasing
NC	No change
NEW	New

(Example: PCTRRW,NEW:LO,LP)

/LEWP:gg	A line echo wave pattern (LEWP) will be encoded using the two-letter LFM grid box location (gg). (Example: /LEWP:KJ,LK,MK,NK,OK,PL).
/BASEhhh:gg	The base of an elevated layer (BASE) will be encoded in hundreds of feet (hhh) (MSL) using the two-letter identifier for the 1/4 LFM grid location (gg). (Example: /BASE090:LO,MO).
/MALFhhh:gg	The occurrence of precipitation which is mostly aloft (MALF) will be encoded. The height (hhh) is reported in hundreds of feet (MSL) and the location (gg) is the 1/4 LFM grid identifier. (Example: /MALF050:KP,KQ).
/PALFhhh:gg	The occurrence of precipitation which is partially aloft (PALF) will be encoded. The height (hhh) is reported in hundreds of feet (MSL) and the location (gg) is the 1/4 LFM grid identifier. (Example: /PALF050:PM,PN).
/MLTLVLhhh	The height (hhh) of the melting level (MLTLVL) in hundreds of feet (MSL) will be encoded. (Example: /MLTLVL075).
/EYEdddfcc:ggg; LATeee.ex, LONeee.ey	The location (ggg) of the eye of a hurricane or tropical storm (EYE), the direction (ddd) from which it is moving and the speed (fff) in knots of movement will be encoded. Confidence in the fix (cc) is reported as good (GF), fair (FF), or poor (PF). Further, the location of the eye will also be encoded in latitude (LAT) and longitude (LON). The location will be expressed in whole degrees and tenths (eee.e) with provision f or specifying north (N), south (S), east (E), or west (W) as appropriate. (Example: /EYE160010GF:OOA;LAT28.4N,LON178.5W).
/CNTRdddfcc:ggg; LATeee.ex LONeee.ey	The location (ggg) of the center of a hurricane or tropical storm (CNTR), the direction (ddd) from which it is moving and the speed (fff) of movement in knots will be encoded. Further, the location of the center will also be encoded in latitude (LAT) and longitude (LON). The location

will be expressed in whole degrees and tenths (eee.e) with provision for specifying north (N), south (s), east (E), or west (W) as appropriate (Example: /CNTR160005:OOA;LAT28.4N,LON178.5W).

/REM: This space is for any other remarks not covered in the above remarks.
 /EDITED:int If the radar coded message has been edited (EDITED), the editor will report such, adding his/her initials (int) (Example: /EDITED:DSS).
 /ENDCC (C/R) End of Part C indicator.

The following is a summary example of the components of Part C:

/NEXRCC sidd 2812881330 (C/R)
 /NTVSnn: TVSnnggg , TVSnnggg , TVSnnggg
 /NMESnn: Mnnggg ,Mnnggg ,Mnnggg
 /NCENnn: Cnnggg ShhhHi ,Cnnggg ShhhHi ,Cnnggg ShhhHi
 PCTRyyyy,aaa:gg
 /LEWP:gg,gg,gg,gg
 /BASEhhh:gg,gg,gg
 /MALFhhh:gg,gg
 /PALFhhh:gg,gg
 /MLTLVLhhh
 /EYEdddffcc :ggg;LATeee.ex,LONeee.ey
 /CNTRdddfff : ggg ;LATeee.ex,LONeee.ey
 /REM:

Intensity trend symbols (Contd)

/EDITED: int
 /ENDCC (C/R)

At the end of the message, the following group is sent:

/ENDALL (C/R)A group to indicate end of message will be provided.